PB90-185422

Compiling Air Toxics Emission Inventories. Second Edition

(U.S.) Environmental Protection Agency, Research Triangle Park, NC

Feb 90

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-450/4-86-010		PB90 185422/AS

4. TITLE AND SUBTITLE	5. REPORT DATE
Compiling Air Toxics Emission Inventories	February 1990 (Revised)
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Dallas W. Safriet U.S. Environmental Protection Agency	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Pollutant Characterization Section (MD-15) Noncriteria Pollutant Programs Branch Air Quality Management Division Research Triangle Park, NC 27711	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report contains technical materials that will assist state and local control agencies in compiling air toxics emission inventories. It contains a discussion of (1) various considerations that should be made in planning and beginning an inventory and (2) various tools an agency can use to locate potential sources and to estimate emissions therefrom. The appendices contain the data needed to use these inventory tools and some example applications of them.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Toxics Emission Inventories Toxic Emissions Screening Inventory Inventory Procedures Hazardous Air Pollutants		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
		78
	20. SECURITY CLASS (This page)	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

PB90-185422

United States
Environmental Protection
Agency

Office of Air Quality
Planning And Standards
Research Triangle Park, NC 27711

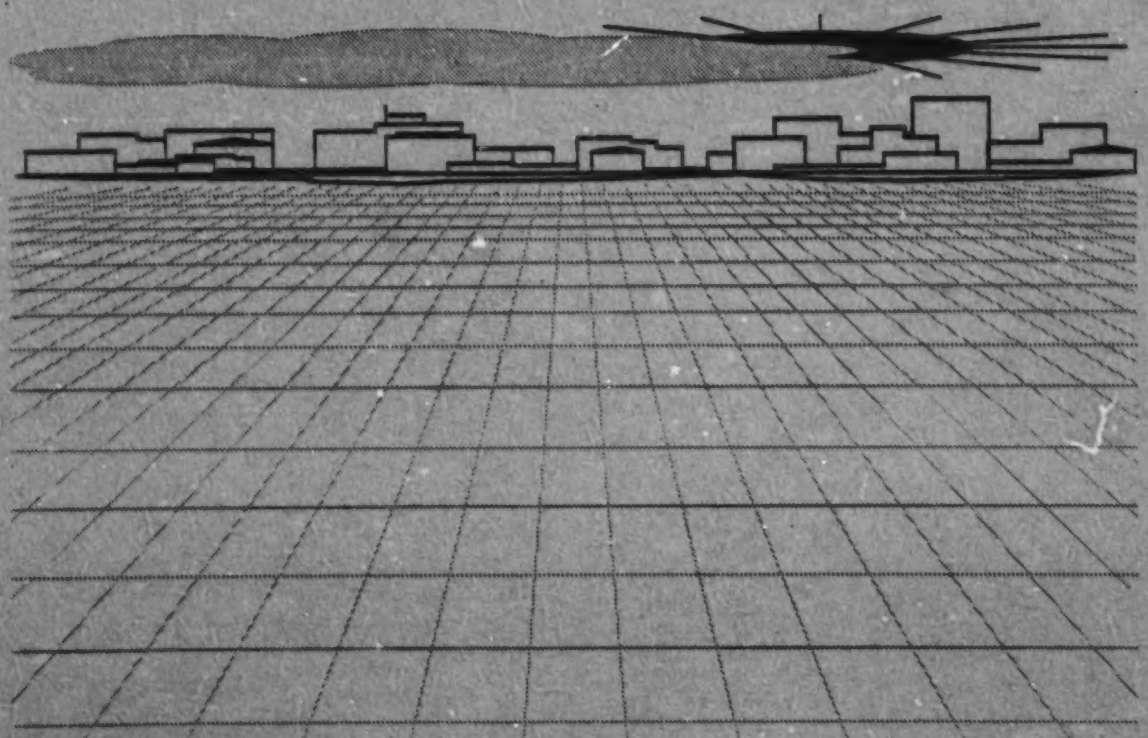
EPA-450/4-86-010
Revised
February 1990

AIR

EPA

COMPILING AIR TOXICS EMISSION INVENTORIES

SECOND EDITION



REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

EPA-450/4-86-010
Revised February 1990

COMPILING AIR TOXICS EMISSION INVENTORIES

SECOND EDITION

Edited and Revised

by

Dallas W. Safriet
Air Quality Management Division
U.S. Environmental Protection Agency

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office Of Air And Radiation
Air Quality Management Division
Office Of Air Quality Planning And Standards
Research Triangle Park, North Carolina 27711

February 1990

This report has been reviewed by the Office Of Air Quality Planning And Standards, U.S. Environmental Protection Agency, and approved for publication. Any mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use.

EPA-450/4-86-010

TABLE OF CONTENTS

Chapter		Page
	List of Tables	v
	List of Figures	vi
1	Introduction	1
2	Anticipated Uses of Air Toxics Emission Inventories	3
	2.1 Uses of Air Toxics Emission Inventories	3
	2.2 Effect of Program Use on Inventory Complexity	5
	2.3 Additional Planning Considerations	6
3	Preliminary Screening Studies	8
	3.1 Screening Considerations	8
	3.2 Overview of Screening Procedures	8
	3.3 Screening Study Error	16
	3.4 Review of Screening Study Results	17
	3.5 Use of Screening Tools Evaluating Permit Applications	18
4	Pollutant Coverage	19
	4.1 "Open-ended" Versus "Directed" Approaches	19
	4.2 State and Local Agency Lists	21
	4.3 Core List of Compounds for Possible Consideration	21
5	Source Category Coverage	24
6	Point/Area Source Distinctions	32
	6.1 Making the Point/Area Source Distinction	32
	6.2 Factors Affecting the Point/Area Distinction	32
7	Geographic Area of Coverage	34
8	Detailed Data Collection and Emission Estimation Procedures	35
	8.1 Locating Sources	35
	8.2 Data Collection	36
	8.3 Emission Estimation Procedures	39

Chapter		Page
8.4	Control Device Applicability and Efficiency ...	40
8.5	Problems in Data Collection and Interpretation.	41
8.6	Sources of Inventory Error	42
9	Summary	43
	References	44

Appendix		Page
A	Example Applications of Screening Tools	A-1
B	Example Air Toxics Production and Use Questionnaire	B-1
C	Glossary of Chemical Name Synonyms	C-1

LIST OF TABLES

TABLE		PAGE
1	Potential Uses of Air Toxics Emission Inventories ...	4
2	Inventory Complexity as a Function of Application ...	6
3	Features of Screening and Detailed Inventories	9
4	Source of Toxic Emission Factor Information	11
5	Example VOC Profile	14
6	Example Particulate Matter Profile	15
7	Percent of Cancer Risk Associated with Point and Area Sources	17
8	Substances Considered by Four or More Agencies	22
9	Core List of Compounds for Consideration in an Air Toxics Emission Inventory	23
10	Nationwide Air Toxics Emissions by Board Source Category	27
11	Example Cutoff Levels and Exempted Sources	33

FIGURE		PAGE
1	Sample Material Safety Data Sheet	38

Chapter 1

INTRODUCTION

The purpose of this report is to offer assistance to those agencies who are getting started in compiling inventories of air toxics emissions. This compilation process may simply involve the development of a preliminary screening inventory or may involve the development of a more detailed and comprehensive inventory, depending on program needs; resources and the nature of the air toxic problem.

Emission inventories have generally been compiled for use in criteria pollutant control programs in order to (1) provide summary information on sources and emissions, (2) help define source/receptor relationships and (3) develop and evaluate alternate control strategies. Air toxics emission inventories are now being developed and used in air toxic control programs for basically the same reasons.

Recent survey information collected for inclusion in the U.S. Environmental Protection Agency's (EPA's) National Air Toxic Information Clearinghouse (NATICH) data base indicates that about 36 States and local agencies have compiled air toxics emission inventories in some form. EPA is strongly emphasizing the development of State and local inventory and other data collection capabilities as part of its National Air Toxics Strategy.[1]

To complement this discussion, several appendices are included which present examples and other useful data in compiling air toxics inventories. The emphasis in these appendices is on presenting various tools and other techniques for identifying pollutants of potential concern and for estimating emissions.

The contents of these appendices are summarized below:

- Appendix A presents example applications of various screening tools that are available to develop preliminary emission estimates.
- Appendix B presents an example of a production and use survey, sometimes used to determine which sources should receive more detailed follow-up questionnaires or to supply emergency response data.
- Appendix C presents a glossary of chemical names/synonyms for commonly inventoried substances, useful in interpretating data supplied by sources.

EPA has published procedures for compiling emissions inventories of criteria pollutants.[2-7] Many of these same procedures will apply to air toxics emission inventory development and an agency's existing criteria pollutant inventory may serve as a good starting point for compiling the air toxics inventory.

The main body provides a general discussion of the issues and concepts involving air toxic inventories. It advises State and local agencies of various considerations that should be taken into account when planning and compiling air toxic inventories. The following topics are discussed that are considered fundamental to any such effort:

- -Anticipated uses of air toxic emission inventories
- -What substances to cover
- -What source categories to cover
- -Point/area source distinctions
- -Geographic area of coverage
- -Source location, data collection and emission estimation procedures (screening and detailed)

This report is primarily geared to helping agencies in the planning and screening portions of their air toxics programs. Such as (1) basic considerations are emphasized that the agency should take into account when planning the inventory effort and (2) simple tools are presented to help the agency make preliminary, screening estimates of source strength without having to make source contacts.

To some extent, the screening tools presented herein can be extended to provide more detailed emission estimates and to screen information provided by sources in permit applications. Also, the references cited in this report, and additionally in the EPA clearinghouse bibliography,[8] will provide some of this support.

CHAPTER 2

ANTICIPATED USES OF AIR TOXICS EMISSION INVENTORIES

The paramount consideration in planning any inventory is how, ultimately, the inventory will be used in the agency's air quality control program. Since air toxics emissions data may also be used in water or solid waste programs or by other agencies, outside groups, and individuals, the needs of these other potential users should also be considered.

2.1 Uses of Air Toxics Emission Inventories

Various uses of air toxics inventories by State and local agencies are summarized in Table 1. Several of the more important of these applications are discussed below.

A. Defining General Source and Emission Patterns

Air toxics inventories can be used for relatively undemanding purposes such as developing preliminary screening estimates for various source categories to help understand broad emission patterns and trends. For example, an agency may want the capability to determine the largest point source emitters of a particular substance in a given area, or determine the relative contribution of certain point and area sources. A screening inventory may help the agency focus on certain pollutants and sources in its detailed inventory. Or an emergency response program may desire the ability to identify whether certain chemicals are stored or used at various plants. These types of applications would not necessarily require the collection of extremely detailed source and emissions data or the development of a sophisticated data handling system to store and manipulate these data. This abbreviated type of inventory may not support detailed exposure modeling or risk assessment analyses, but would allow the agency to start defining its air toxics problem and prioritizing subsequent data collection activities. (Screening is discussed in more detail in Chapter 3.)

B. Point Source Emission Modeling

Many agencies use their inventories to provide input to various kinds of dispersion models for estimating ambient air concentrations and new and/or existing point sources. Typically, in this approach, these modeled ambient air levels are then compared with ambient air standards or guidelines (such as occupational exposure limits divided by a safety factor) to determine what control may be required. In this type of program, each source is generally evaluated as if it were an isolated emitter, without consideration of the aggregate effects of nearby sources.

TABLE 1

POTENTIAL USES OF AIR TOXICS EMISSION INVENTORIES

1. To satisfy a legislative or other mandate

2. To identify sources and general emission strengths, patterns, and trends

3. To store data from related programs

   e.g. -- permit/registration/compliance data
   -- emergency preparedness data
   -- right-to-know data
   -- act as "tickler file" for permit review and enforcement action

4. To site ambient air monitors

5. To provide input to point source dispersion models to predict ambient air levels

   e.g. -- to compare with acceptable ambient air levels (AALs)
   -- to determine maximum individual risks and aggregate incidence

6. To focus subsequent inventory work or other program development efforts

7. To identify multiple source and multiple pollutant problem areas characterized by high additive risk

8. To develop control strategies and regulations

Note: This is not intended to be all inclusive. It reflects uses indicated by various State and local agencies and EPA.

In general, the kinds of data needed for modeling air toxics around point sources are the same as for criteria pollutants since, for most releases, air toxics are assumed to behave in the same ways as criteria pollutants. (Some accidental releases may involve such large quantities of heavier-than-air compounds that conventional Gaussian plume modeling may not be applicable.) Indeed, the same dispersion models (e.g., SCREEN, CDM, ISC) may be used in certain air toxics applications. To model point sources, detailed stack, exhaust and sometimes building parameters are needed as well as temporally resolve emission estimates. Different and more exacting source data may be required for modeling short-term releases than for projecting annual averages. The input requirements to each model will vary, of course, and cannot be summarized here. Various available models are described in Reference 9 and 10.

Some models require more detailed source and emissions data than the agency may feel are reasonable to collect or estimate for all sources and all pollutants. In this situation, the agency may opt, instead, to prepare a detailed ad hoc inventory only in those special situations where complex modeling is necessary.

C. Multiple Source/Pollutant Assessment and Control Strategy Development

A few programs are starting to go beyond individual point source assessment and are beginning to evaluate the impact of all sources of air toxics in some areas. To evaluate the impact of aggregations of point and area sources in an area, an agency must consider minor point and area sources as well as major point sources. Such assessments may entail the use of areawide dispersion and exposure models which require detailed source and emissions data for both major and minor point sources as well as spatially resolved estimates for area sources. The inclusion of minor point and area sources in the air toxics inventory requires more resource expenditure than just including major point sources. The use of air toxics emissions data in multiple source/pollutant assessments and control strategy development represents the most demanding use of these emission inventories.

2.2 Effect of Program Use on Inventory Complexity

Different levels of detail are needed depending on the anticipated uses of the inventory. Table 2 shows some of the inventory parameters that increase in complexity as the inventory applications become more demanding. Because this is such an important consideration, the agency should determine what uses the air toxics inventory will be put to at the outset of the inventory planning process. The important point is that the inventory agency must be aware of all of the projected uses of the inventory before commencing with data collection. In general, inventory design and data collection needs will be determined by the most demanding applications of the inventory.

TABLE 2

INVENTORY COMPLEXITY AS A FUNCTION OF APPLICATION

Inventory Use	Level of Complexity
Less Demanding Applications	Simple Data Summaries
↓	Aggregated Source Data
↓	Major Point Source Emphasis
↓	More Source Contacts
↓	Stack and Exhaust Data
↓	Control Equipment Type And Efficiency
↓	Spatial And Temporal Resolution
↓	Inclusion Of Minor And Area Sources
↓	Control Strategy Simulation Capability
More Demanding Applications	Complex Data Handling Capability

Note: Refer to Table 1 for various applications of air toxics emission inventories. In general, the applications in Table 1 become more demanding with increasing order of listing.)

2.3 Additional Planning Considerations

Several other considerations should be made in the early planning stages that will effect the usefulness of the air toxics inventory. These are discussed as follows.

A. Actual vs. Allowable Emissions

Agencies typically include estimates of actual emissions in their inventories. Some agencies also include allowable emissions, perhaps as reflected in each source's permit. The inclusion of allowable emissions may be useful to the agency in certain modeling control or compliance programs.

B. Annual vs. Short Term Emissions

Agencies traditionally have compiled estimates of annual emissions. Annual estimates of air toxic emissions are appropriate when the agency is evaluating potential cancer risks since carcinogenesis involves long term exposures. Shorter term emission estimates may also be useful for modeling short term, maximum concentrations around certain sources, such as when estimating acute health effects posed by certain pollutants. In addition, allowable emission limits may be expressed on a short term time frame.

C. Accidental vs. Routine (predictable) Emissions

Agencies have generally only considered routine, predictable emissions in their inventories, i.e., those emissions that could be expected to recur in a certain time frame. Routine emissions would include continuous emissions, both process and fugitive, and intermittent emissions from scheduled, but discontinuous, operations (e.g., batch processes, startups, shutdown and maintenance operations). Accidental releases would be short term and unscheduled and may involve events that are catastrophic in nature. Accidental events could involve control equipment failure or bypass, pressure relief, equipment openings and spills. There is a fine line between what some may consider irregularly occurring, but predictable, events and accidental events. The latter would not necessarily be expected to happen at every plant within a given reporting year and may be difficult to handle in a representative manner in the air toxics inventory.

D. Process vs. Fugitive Emissions

Process, or stack, emissions have traditionally been the focal point of emission inventories. Fugitive emissions can be a very important component from some source categories (e.g., organic chemical manufacturing) and should not be overlooked. Important sources of fugitive emissions include material storage, loading and unloading operations, process valves, flanges, pump seals, open-ended lines, sampling ports, etc.

CHAPTER 3

PRELIMINARY SCREENING OF SOURCES AND EMISSIONS

It may prove helpful as part of the planning process to conduct some sort of screening study before commencing with the detailed air toxics inventory. The general idea of a screening study is to develop preliminary estimates of emissions and associated risks in order for the agency to focus its program and resources on the most important sources and pollutants. EPA's "Six-Month Study" is an example of a national screening study conducted to evaluate maximum individual lifetime risks, additive risks and aggregate cancer incidence.[11] Table 3 contrasts the features of the screening and detailed emission inventories.

3.1 Screening Considerations

As part of the screening study, the agency may consider more than just emissions -- ambient air concentrations and health data may also be factored into the screening process. The screening study should afford the agency with enough perspective to determine the following:

- What pollutants should be covered in more detail?
- What source categories should be emphasized?
- What geographic areas should be covered? Is there is a need to focus on areas of high additive risk from multiple sources and pollutants?
- What is the relative importance of major and minor sources and area sources?
- To what extent can the existing criteria pollutant inventory and permit files be used as a foundation for the air toxics inventory?

Ideally, the screening study should be performed quickly and inexpensively and yet yield results the agency has sufficient confidence in to make decisions concerning program direction. Screening can be an iterative process, with more focus placed on certain pollutants and sources as the agency's perception of its air toxics problem unfolds and as resources allow.

3.2 Overview of Screening Procedures

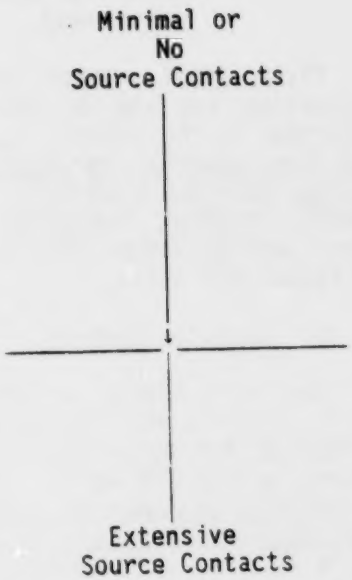
To minimize resources and time spent on the screening study, the agency should try to identify as many sources and to make as many emission estimates as possible using available data without making expensive and time consuming source contacts. A number of screening tools are available to help the agency identify potential emitters of air toxics and develop preliminary emission estimates. These tools are described as follows, with the applicability of each tool discussed below. With example applications shown in Appendix A.

TABLE 3

FEATURES OF SCREENING AND DETAILED INVENTORIES

Screening Inventory

- Done first
- Preliminary emission estimates
- Minimal source contacts
- Maximum use of available data
- Can cover a large number of pollutants
- Can cover all potential sources
- Broad geographical coverage



Detailed Inventory

- Follows screening inventory
- Detailed emission estimates
- Extensive source contacts
- May be selective e.g., many factors
  particular areas per screening study
  results

Used for ....

- e.g., may focus on particular sources
- e.g., may focus on particular pollutants

A. Source Category-Pollutant Cross-Indexes

These are tables associating source categories with pollutants, showing the potential for a given substance to be emitted by a particular facility. This qualitative identification process can be useful for two purposes:

i. to determine which sources to send questionnaire to if the agency is focusing on specific pollutants; and

ii. to direct the agency to the appropriate emission factors, speciation factors, etc., if the agency is going to make screening estimates itself (as opposed to sending out questionnaires).

These cross indexes could also be used by the agency to help evaluate application for new or revised operating permits. Such a cross index is contained in the report, Toxic Air Pollutant/Source Crosswalk - A Screening Tool For Locating Possible Sources Emitting Toxic Air Pollutants, Second Edition (EPA-450/2-89-017). The cross-walk contains pollutant names, CAS numbers, Standard Industrial Classification (SIC) codes, and emitting source classification codes (SCC's). The crosswalk tables are sorted by pollutant, SIC codes, and SCC's.

B. Emission Factors

Just as criteria pollutant emission factors can be applied to activity levels or throughput to estimate emissions, so can air toxic emission factors be applied for this same purpose. The major source of air toxics emission factors is the EPA series entitled Locating And Estimating Air Emissions From Sources Of (Substance Or Source Category) and the document Toxic Air Pollutant Emission Factors A Compilation For Selected Air Toxic Compounds And Sources (Table 4 shows a listing). The compilation is a general emission factor listing for more pollutants than contained in the Locating And Estimating series. The document list available air toxic emission factors and references from which the emission factors are obtained.

A database management system for use on IBM™ compatible personal computers has been developed that contain all crosswalk data and air toxic emission factors in the report discussed earlier plus recent updates. The system, XATEF, is now available and was last updated in October, 1989. A system user's Manual entitle Crosswalk/Air Toxic Emission Factor Data Base Management System User's Manual is also available to explain the use of data management software.

TABLE 4

SOURCE OF TOXIC EMISSION FACTOR INFORMATION

LOCATING AND ESTIMATING SERIES

SUBSTANCE OR SOURCE CATEGORY	EPA PUBLICATION NUMBER	NTIS ORDER NUMBER	DATE
Acrylonitrile	EPA-450/4-84-007a	PB-84-200609	1984
Carbon Tetrachloride	EPA-450/4-84-007b	PB-84-200625	1984
Chloroform	EPA-450/4-84-007c	PB-84-200617	1984
Ethylene Dichloride	EPA-450/4-84-007d	PB-84-239193	1984
Formaldehyde	EPA-450/4-84-007e	PB-84-200633	1984
Nickel	EPA-450/4-84-007f	PB-84-210988	1984
Chromium	EPA-450/4-84-007g	PB-85-106474	1985
Manganese	EPA-450/4-84-007h	PB-86-117587	1986
Phosgene	EPA-450/4-84-007i	PB-86-117595	1986
Epichlorohydrin	EPA-450/4-84-007j	PB-86-117603	1986
Vinylidene Chloride	EPA-450/4-84-007k	PB-86-117611	1986
Ethylene Oxide	EPA-450/4-84-007l	PB-87-113973	1987
Chlorobenzenes	EPA-450/4-84-007m	PB-87-189841	1987
Polychlorinated Biphenyls (PCBs)	EPA-450/4-84-007n	PB-87-209540	1987
Polycyclic Organic Matter (POM)	EPA-450/4-84-007p	PB-88-149059	1988
Benzene	EPA-450/4-84-007q	PB-88-196175	1988
Organic Liquid Storage Tanks	EPA-450/4-88-004	PB-89-129019	1988
Coal and Oil Combustion Sources	EPA-450/2-89-001	PB-89-194229	1989
Municipal Waste Combustors	EPA-450/2-89-006	PB-89-195226	1989
Perchloroethylene and Trichloroethylene	EPA-450/2-89-013	PB-89-235501	1989
Chromium (Supplement)	EPA-450/2-89-002	PB-90-103243	1989
1,3 Butadiene	EPA-450/2-89-021	(not assigned)	1989

Sewage Sludge Incineration is to be released in 1990.

OTHER REPORTS

1. Toxic Air Pollutant Emission Factors for Selected Air Toxics Compounds and Sources, EPA-450/20-88-006a, NTIS, PB 89-135644. October 1988.

2. Compilation And Speciation Of National Emissions Factors For Consumer/ Commercial Solvent Use, EPA-450/2-89-008, NTIS Number: PB-89-207203.

3. Procedures For Estimating And Allocating Area Source Emissions Of Air Toxics, Working Draft.

Another potential source of emission factor information is EPA's National Air Toxic Information Clearinghouse (NATICH) data base.[12] States and local agencies have submitted permit and source test information to the clearinghouse that may be of assistance in determining emission rates for many kinds of industrial facilities.

Contact names and phones numbers are also given, allowing the user the opportunity to get more specific directly from the supplying agency. As more data are supplied, the Clearinghouse should improve as a source of emission data.

In general, emission factors are a useful screening technique since they can be applied to the level of activity specified in the existing criteria pollutant inventory or permit file to estimate emissions of air toxics. Emission factors are applicable for estimating emissions of sources for which factors are available and for which appropriate source information is available to apply them. An example emission factor application is shown in Appendix A.

C. Speciation Factors Or Profiles

These are factors that can be applied directly to volatile organic compounds (VOC) or particulate matter (PM) totals in an existing criteria pollutant inventory or permit file to yield estimates of air toxics emissions. They are distinguished from emission factors in that they apply to VOC and PM emissions rather than activity levels or throughputs.

The VOC and PM speciation factors or profiles can be found in the two volume Air Emissions Species Manual.[13] Speciation factors are used to estimate emissions of air toxics from emission factors or estimates of total VOC's or PM. Both volumes are similarly organized with speciation data presented by source category and by SCC. Volumes are updated periodically.

VOC Data Base (Volume I). The VOC volume is a major revision of an earlier EPA document entitled VOC Species Data Manual. About 75 percent of the 250 profiles in the document are new or revised. In addition to the original VOC profiles, this document contains VOC profiles for all SCC's in the National Emissions Data System (NEDS) and applicable NEDS area source codes.

PM Data Base (Volume II). The PM volume is a revision of an earlier EPA document, Receptor Model Source Composition Library. Only minor changes have been made in data and report format in the new document. There are over 250

PM profiles in this document, assigned for all NEDS SCC's and many area sources. The format of the PM profiles are similar to the VOC profile tables except for the presentation of particle size distributions for each species.

A data base management system for use on IBM™ compatible personal computers is also now available. This data base may contain more recent and additional information beyond the latest published version. Example of the species profile are shown in Tables 5 and 6.

D. Conservative Material Balances

For some combustion sources, solvent users and other evaporative loss sources, conservative assumptions can often be made concerning the fraction of a material input to or used by a process that is emitted. Commonly, all makeup solvent used by certain operations is assumed to be evaporated and a large fraction of metals in fuels is assumed to be exhausted. Hence, for many operations, screening estimates can be generated by making reasonable assumptions about the amount a toxic substance in a solvent, fuel, or process feed and then applying this to activity level information in the existing criteria pollutant inventory or permit file. Examples of the application of conservative material balances are given in Appendix A.

E. Existing Source Data/Emission Estimates

The literature, permit and registration files, and NATICH contain source data and/or emission estimates (and in some cases, risk assessments) for many substances that may suffice for screening purposes. This is especially likely for many large production (e.g., SOCMI) facilities and facilities required to obtain a permit. For example, references 14 through 19 provide source locations, operating data and emission estimates for sources of ethylene dichloride, methylene chloride, carbon tetrachloride, trichloroethylene, chloroform, and perchlorothylene, respectively. The EPA Air Toxics Clearinghouse stores source and emissions data on thousands of facilities that have been submitted by States and local agencies, as well as risk estimates that have been computed by EPA for certain sources under the NESHAPS process. The Air Toxics Clearinghouse also publishes a bibliography of references that may be useful in locating data and emission estimates.

TABLE 5

EXAMPLE VOC PROFILE

VOC Profile Speciation Report

Profile Name : Crude Oil Production - Well heads (Gas Drive)
Profile Number: 1212
Data Quality : C

Control Device: Uncontrolled
Reference(s) : 96
Data Source : Crude comes from the Oklahoma Dutcher formation which is at a depth of 1,400 feet. Four samples were taken in stainless steel canisters and analyzed using a GC with cryogenic sample pre-concentration and flame ionization detection.
SCC Assignments: 31000101

SAROAD	CAS Number	Name	Spec_MW	Percent Weight
43202	74-84-0	Ethane	30.07	17.52
43204	74-98-6	Propane	44.09	32.63
43212	106-97-8	N-Butane	58.12	21.33
43220	109-66-0	N-Pentane	72.15	6.46
43229	107-83-5	2-Methylpentane	86.17	1.48
43230	96-14-0	3-Methyl Pentane	86.17	0.83
43231	110-54-3	Hexane	86.17	1.68
43232	142-82-5	Heptane	100.20	0.68
43233	111-65-9	Octane	114.23	0.68
43242	287-92-3	Cyclopentane	70.14	0.38
43247	108-08-7	2,4-Dimethylpentane	100.20	0.05
43248	110-82-7	Cyclohexane	84.16	0.68
43261	108-87-2	Methylcyclohexane	98.2	10.74
43262	96-37-7	Methylcyclopentane	84.16	1.04
43263	591-76-4	2-Methyl Hexane	100.20	0.24
43274	565-59-3	2,3 Dimethyl Pentane	100.20	0.11
43276	79-29-8	2,3 Dimethylbutane	86.1	70.17
43288	1678-91-7	Ethylcyclohexane	112.23	0.09
43291	75-83-2	2,2-Dimethylbutane	86.17	0.05
43295	589-34-4	3-Methylhexane	100.20	0.32
43296	592-27-8	2-Methylheptane	114.23	0.23
43298	592-27-8	3-Methylheptane	114.23	0.10
43910	75-28-5	2-Me-Propane	58.10	6.44
43911	78-78-4	2-Me-Butane	72.20	5.56
43912	540-84-1	2,2,4-Trime-Pentane	114.20	0.32
45201	71-43-2	Benzene	78.11	0.05
45202	108-88-3	Toluene	92.13	0.09
45203	100-41-4	Ethylbenzene	106.16	0.02
45204	95-47-6	O-Xylene	106.16	0.03
90010		M-Xylene and P-Xylene	106.16	0.12
TOTAL				99.69

TABLE 6

EXAMPLE PARTICULATE MATTER PROFILE

PM Profile Speciation Report

Profile Name : Primary Copper Roaster
Profile Number : 29209
Data Quality : D

Control Device : Uncontrolled(1)
Reference(s) : 1,18
Data Source : Data taken from Reference 1. For details, consult Reference 18.

SCC Assignments: 30300502, 30300509

Mass Fraction Data - Size Interval (μm): (0-2.5) (0-6) (0-10)
Mass Fraction : 0.970 1.000 1.000

Total Particulate Matter -

Cas Number	Species Num	Species Sym	0-2.5 μm % wt	0-2.5 μm unc	2.5-10 μm % wt	2.5-10 μm unc	0-10 μm % wt	0-10 μm unc	Total Measured (2) % wt	Total Measured (2) unc
7429-90-5	13	AL	6.200	0.600	2.400	0.200	2.621	1.096	2.621	0.000
7440-21-3	14	Si	13.500	1.200	4.800	0.500	5.293	2.300	5.293	0.000
7704-34-9	16	S	9.800	0.900	8.100	0.300	8.196	1.830	8.196	0.000
7782-50-5	17	CL	0.000	0.100	0.000	0.100	0.000	0.138	0.000	0.000
7440-09-7	19	K	1.010	0.100	0.420	0.080	0.453	0.201	0.453	0.000
7440-70-2	20	Ca	2.000	0.170	1.620	0.110	1.642	0.393	1.642	0.000
7440-32-6	22	Ti	0.260	0.050	0.160	0.040	0.166	0.083	0.166	0.000
7440-62-2	23	V	0.000	0.050	0.000	0.040	0.000	0.062	0.000	0.000
7440-47-3	24	Cr	0.066	0.015	0.040	0.020	0.042	0.033	0.042	0.000
7439-96-5	25	Mn	0.137	0.015	0.081	0.018	0.084	0.041	0.084	0.000
7439-89-6	26	Fe	18.600	1.500	13.000	0.600	13.317	3.269	13.317	0.000
7440-02-0	28	Ni	0.110	0.050	0.000	0.080	0.006	0.094	0.006	0.000
7440-50-8	29	Cu	18.600	1.500	18.400	1.900	18.411	3.935	18.411	0.000
7440-66-6	30	Zn	1.090	0.120	1.920	0.080	1.024	0.248	1.024	0.000
7440-38-2	33	As	4.200	0.400	3.700	0.600	3.728	0.998	3.728	0.000
7782-49-2	34	Se	0.000	0.050	0.000	0.030	0.000	0.057	0.000	0.000
7726-95-6	35	Br	0.000	0.300	0.000	0.200	0.000	0.351	0.000	0.000
7440-17-7	37	Rb	0.000	0.040	0.000	0.050	0.000	0.063	0.000	0.000
7440-24-6	38	Sr	0.000	0.050	0.020	0.040	0.003	0.044	0.003	0.000
7440-65-5	39	Y	0.000	0.030	0.000	0.040	0.000	0.049	0.003	0.000
7439-98-7	42	Mo	0.160	0.050	0.120	0.040	0.122	0.075	0.122	0.000
7440-22-4	47	Ag	0.000	0.200	0.042	0.010	0.040	0.195	0.040	0.000
7440-43-9	48	Cd	0.000	0.200	0.000	0.020	0.000	0.195	0.000	0.000
7440-74-6	49	In	0.000	0.200	0.000	0.020	0.000	0.195	0.000	0.000
7440-31-5	50	Sn	0.000	0.200	0.000	0.020	0.000	0.195	0.000	0.000
7440-36-0	51	Sb	0.340	0.160	0.076	0.021	0.091	0.166	0.091	0.000
13494-80-9	52	Te	0.000	0.200	0.000	0.000	0.000	0.218	0.000	0.000
7439-97-6	80	Hg	0.000	0.100	0.000	0.040	0.000	0.105	0.000	0.000
7439-92-1	82	Pb	2.130	0.180	1.750	0.100	1.772	0.413	1.772	0.000
7440-69-9	83	Bi	0.300	0.100	1.060	0.030	0.074	0.112	0.074	0.000
TOTALS			**78.653**		**55.789**		**57.085**		**57.085**	

(1) No controlled specified: thus, assumed uncontrolled.
(2) Estimated / extrapolated.

Another resource is the Superfund Amendments and Reauthorization Act Section 313 (SARA 313) Inventory. By July 1, 1988 many facilities were required to complete SARA 313 inventory release forms. Working from a list of 329 compounds and groups of compounds, extensive sources will be covered. This new information can help States and local agencies to identify affected sources, pollutants being emitted, and estimates of total plant emissions, etc. It will not, however, provide individual stack data, the size of sources, or plant layouts. The industry must provide total plant estimates of point-sources and nonpoint source (fugitive) air emissions. This information should be useful as a screening tool to focus on potential air toxics hot spots, or to help select what air toxics pollutants to include in the inventory permit program or source registration process.

What these screening tools have in common is that they allow the agency to identify potential emitters and make screening estimates without making time consuming and expensive source contacts. Once the screening study is complete, the detailed air toxics inventory can commence, if necessary. In some cases, the screening study may divulge that a detailed inventory may not be necessary, at least for some pollutants or in some areas. Or it may turn out that selective coverage, either for specific sources, pollutants or for small areas, may be sufficient for program planning and control purposes. This is the point of the screening process -- to help the agency avoid expending resources on activities that do not yield significant reductions in air toxic emissions and risks. This allows the bulk of available agency resources to be devoted to more detailed data collection and analysis and to focus on those pollutants, sources, and geographic areas that pose most risk to the community.

Table 7 shows an example of possible results from an inventory screening study where the emissions data have been modeled to estimate aggregate cancer incidence. These data show the relative risk associated with various point and area sources in a given area. This kind of screening exercise would provide some basis for the agency to focus any subsequent data collection and control effort. Of course, any screening estimates of emissions and risk would probably be considered preliminary, to be followed by more detailed estimates for the more important sources and pollutants.

3.3 Screening Study Error

Because crude techniques may be used in screening studies, errors are unavoidable. Hence, it is generally advisable to be conservative in such studies, i.e., to develop estimates that do not underestimate emissions and associated risks. Since the point of the screening study is to identify areas where additional attention is needed, it is better to overestimate emissions than to underestimate emissions. Presumably, overestimates of emissions will be put into proper perspective later on in the inventory process, but underestimates could conceivably lead to false conclusions that may not be corrected. One way to deal with potential errors is to view the screening process as an iterative one. That is, instead of assuming that the focus for

the entire program can be correctly ascertained from a single screening, the agency might opt to keep the process open for a second iteration to fine tune the results.

TABLE 7

PERCENT OF CANCER RISK ASSOCIATED WITH POINT AND AREA SOURCES[a]

Point Sources	% of Total Incidence[b]
Chemical production/usage	10
Metal Manufacturing	8
Petroleum Refining	5
Rubber Production	5
Utilities	3
Publicly Owned Treatment Works (POTWs)	2
All Others	16
Total Point Source	**49**
Area Sources	
Road Vehicles	22
Solvent Usage	10
Gasoline Marketing	9
Waste Oil Burning	8
Woodsmoke (stoves/fireplaces)	0.5
All Other	1.5
Total Area Source	**51**

[a]In 35 counties, from Reference 20.
[b]Because of the uncertainties in the incidence calculations used to derive these estimates, the numbers should be regarded as rough indicators only. They will not necessarily apply to any given geographical area.

3.4 Review of Screening Study Results

It may prove helpful at the end of the screening study (or later, after the detailed inventory) to make the results available for outside review, at least in summary form. This review could involve having various noninventory personnel review the results to see if the data patterns and conclusions appear reasonable.

Reviewers should include persons that are sufficiently detached from the inventory process so they will not be reluctant to point out possible errors and shortcomings. Equally important, these reviewers should include potential users of the air toxics inventory data such as modelers and planners who will

need the data to assist in control strategy development. And, at some point, comments from outside interests may be desirable, including industry, health specialists and environmental groups. Often, bringing differing and diverse viewpoints into a process can be quite helpful in spotting anomalies, misrepresentations, or shortcomings that may not be detected by those directly involved in inventory effort. This review process will heighten the visibility and credibility of the air toxics inventory, assisting any subsequent data collection efforts and improving the likelihood of acceptance of any control program based on these data.

3.5 Use of Screening Tools in Evaluating Permit Applications

The emission inventory screening tools presented in this report may be useful to agency permitting staff in evaluating permit applications (either permit renewals or permits for new or modified sources) for air toxics. The typical permit review period (e.g., 90 days) does not allow for detailed research; therefore, these tools can be of great importance. Whereas the screening tools may not always provide the level of detail or accuracy necessary for complete evaluation of permit applications with respect to air toxic emissions, they can provide information useful in determining which applicants need to provide more detailed information. The results of the permit process can feed into the air toxics emission inventory, thus providing an improving foundation of information useful in future permit reviews and in developing other aspects of regulatory programs.

The first step in reviewing permit applications is to determine if all toxic pollutants of concern potentially emitted by the proposed source are accounted for and if the stated emission levels are reasonably accurate. Such information may be needed initially to determine the applicability of the permitting requirements. Air toxics emissions screening tools may be useful in determining whether the source potentially emits specific pollutants subject to regulation under the Act or other toxic compounds of concern to State or local permitting agencies. For example, the permitting staff could use the source category/pollutant indices, emission factors or speciation factors to determine if all pollutants of concern have been included in the permit application.

Where emission estimates are relatively uncertain (e.g., for new processes), agencies with operative programs sometimes require emissions tests or other means of verification.

POLLUTANT COVERAGE

The major difference between air toxics inventories and criteria pollutant inventories is in substance coverage. Since there are literally thousands of potentially toxic substances as compared to only a handful of criteria pollutants, the compilation effort can become formidable since data collection and data handling resource needs increase quickly as more and more substances are inventoried. In this regard, limiting the number of substances included in the detailed inventory to those causing most of the problem may be one of the most valuable outcomes of the screening study.

4.1 "Open-ended" Vs. "Directed" Approaches

There are two fundamentally different approaches that can be taken when soliciting air toxics emissions data: The "open-ended" and "directed" approaches. In the open-ended approach, the agency asks each source to submit data on whatever air toxics it emits, either without specifying any compounds of interest or by specifying a very broad list containing perhaps hundreds of compounds. The open-ended approach is commonly used in permit-based inventories where point source applicants are asked to submit information on whatever compounds they expect to emit. By contrast, in the directed approach, the agency may target a fairly limited number of compounds it wants to focus on.

A potential advantage to the open-ended approach is that a single "one shot" data collection effort can be employed to get information on most, if not all, toxics being emitted in an area. In theory, this approach may provide a better overall perspective of an area's air toxics problem than will the direct approach because the agency need not have predetermined what substances are most important.

The disadvantages to the open-ended approach are several:

- Without some focus on a limited number of compounds, questionnaire respondents may overlook and not report the use and/or emissions of many air toxics. This may particularly be the case if such compounds are present at low levels or as contaminants in a facility's product, feed stock materials, etc., or if trade name solvents are used and the respondent does not know what comprises them. In this latter regard, many chemical synonyms and trade names may be reported that the agency cannot readily interpret. For example, a source may report it uses Dutch liquid in its process, which is an alternative name for ethylene dichloride (EDC). Or, hypothetically, a source may report that it uses a material named "Super Solvent No. 209" which may contain a large number of substances, including toluene, xylenes, etc. Unless the State or local agency can associate these synonyms and trade names with specific compounds of interest in its air toxics inventory, it may find itself unable to utilize much of the data submitted by various

respondents. (Chemical name synonyms for commonly inventoried substances are presented in Appendix C. The use of Material Safety Data Sheets and other techniques for determining compositions of trade name products is discussed in Chapter 8.)

-The inventory agency may receive much more information than it needs or is prepared to deal with, especially for compounds not emitted at problem levels.

-Unless sufficient quality checks and followup contacts can be made, the response rates may be low and the data suspect.

-Industry may resist reporting on hundreds of substances without regard for the level at which each substance is emitted. One way to counter this objection is to develop a set of conditions that allow certain source/emission level/pollutant combinations to be exempted from detailed reporting. For example, an agency could exclude from reporting any emissions resulting solely from the combustion of unadulterated fuels. Or it might exclude from reporting any emissions of certain compounds discharged below certain rates. Substances toxicity may also be factored into the agency's exemption criteria. (This is discussed more in Chapter 6.)

In the directed approach, an agency may focus on a specific set of compounds it is interested in based on recommendations from a health group or possibly as a result of an emissions screening study. Advantages of the directed approach are:

-It generally allows the agency to focus its data collection effort on fewer sources, targeting those which it believes are probable emitters of the particular substances on its list.

-The amount of data obtained may be much more manageable.

Disadvantages are:

-Additional contacts to the same sources may become necessary if the initial list of pollutants is expanded by the agency. (This may be acceptable if the additional compounds are phased in over the course of the normal update cycle.)

-The agency must either have some predetermined idea of what compounds are important at the outset of the inventory effort or else it must arbitrarily use a designated list. Unless the agency has performed a preliminary screening survey of some sort to determine the major compounds of potential concern, it runs the risk of wasting resources on relatively unimportant compounds while possibly neglecting some compounds actually posing considerable hazard.

4.2 State and Local Agency Lists

Recent surveys of existing air toxics programs indicate that many agencies use a specific list of substances whereas others accept open-ended submissions and a few have hybrid programs -- apparently targeting a specific list of substances but accepting data submitted on any substance.

Several common rationale for selecting a group of compounds are listed below. All of these rationale are not mutually exclusive and more than one rationale may be the basis for selection in some agencies.

- -Substance toxicity (most common rationale)
- -Emissions potential
- -Substance toxicity and emissions potential
- -Use an EPA list
  - e.g. -NESHAPS and NESHAPS candidate substances
    - -Acute Hazard List
- -Adopt list used by another State or local agency
- -List mandated to agency (e.g., by a legislature)

The actual compounds selected for inclusion in agency programs vary considerably, and space precludes presenting or summarizing all of the lists or compounds. However, a number of compounds are commonly included in many agency lists. Table 8 shows 64 compounds that are common to at least 4 agency's lists. Reference 21 presents methods for pollutant selection and prioritization used by various agencies.

4.3 Core List of Compounds for Possible Consideration

EPA is not recommending a specific list of compounds for inclusion in a given area's air toxics inventory. Unlike criteria pollutants, many air toxics are not emitted in every locale. Some air toxics, of course, will be fairly widespread, such as those associated with general solvent use and area sources (e.g., benzene, toluene, xylenes, formaldehyde, perchloroethylene, methyl chloroform, methylene chloride and trichloroethylene). These substances would be emitted in most urban areas. However, many compounds that are primarily associated with point sources (e.g., epichlorohydrin, acrylonitrile, phosgene, etc.), might only be emitted by a few large producers or users in the entire U.S. and may not be emitted in significant levels at all in most areas.

As starting point, in the absence of locale-specific screening results, an agency may consider inventorying the compounds in Table 9 for which EPA has set NESHAPS under Section 112 of the Clean Air Act, or has listed or intends to list in the near future, and/or that were identified as important contributors to aggregate cancer incidence in EPA's "Six-Month Study."[11] Most of these compounds will be emitted in industrialized urban areas and, because these compounds are important from a national risk standpoint, a considerable amount of work has been done or is underway to analyze and characterize them.

Hence, these compounds will generally have better data bases associated with them than are available for many other noncriteria substances. The availability of these data will greatly assist in inventory preparation.

TABLE 8

SUBSTANCES CONSIDERED BY FOUR OR MORE AGENCIES

Acetaldehyde	3,3-Dichlorobenzidine
Acrolein	Dimethyl Sulfate
Acrylonitrile	1,4-Dioxane
Allyl Chloride	Dioxins
Arsenic	Epichlorohydrin
Asbestos	Ethylene Dibromide
Benzene	Ethylene Dichloride
Benzidine	Ethylene Oxide
Benzo(a)pyrene	Formaldehyde
Benzyl Chloride	Heptachlor
Beryllium	Hexachlorocyclopentadiene
Biz(chloromethyl)ether	Hydrazine
1,3-Butadiene	Hydrogen Sulfide
Cadmium	Lead
Carbon Tetrachloride	Lindane
Chlordane	Maleic Anhydride
Chlorobenzene	Manganese
Chloroform	Mercury
Chloroprene	Methyl Bromide
Chromium	Methyl Chloride
Cresol	Methyl Chloroform
1,4-Dichlorobenzene	Methylene Chloride
Beta-Naphthylamine	Polycyclic Aromatic Hydrocarbons (PAH)*
Nickel	Propylene Oxide
Nitrobenzene	Radionuclides
N-nitrosodimethylamine	Styrene
Nitrosomorpholine	Tetrahydrofuran
Parathion	Toluene
Perchloroethylene	Trichloroethylene
Phenol and Chlorinated Phenols	Vinyl Chloride
Phosgene	Vinylidene Chloride
Polychlorinated Biphenyls (PCB)	Xylene

*Also defined as "PIC" (or products of incomplete combustion) in EPA's "Six-Month Study."[11] B(a)P is used as a surrogate for calculating risk and aggregate cancer incidence from PIC exposure in this study.

TABLE 9

CORE LIST OF COMPOUNDS FOR CONSIDERATION IN AN AIR TOXICS EMISSION INVENTORY[a]

Arsenic	Ethylene Oxide
Asbestos	Formaldehyde
Benzene	Gasoline Vapors
Beryllium	Mercury
1,3 Butadine	Methylene Chloride
Cadmium	Perchloroethylene
Carbon Tetrachloride	Polycyclic Organic Matter[b]
Chloroform	Radionuclides
Chromium	Trichloroethylene
Coke Oven Emissions	Vinyl Chloride
Ethylene Dibromide	Vinylidene Chloride
Ethylene Dichoride	

[a]As mentioned in the text, these compounds were selected because EPA has (1) set NESHAPS for them under Section 112 of the Clean Air Act, or has listed or intends to list them, or (2) identified them as important contributors to aggregate cancer incidence in its Six-Month Study.[11]

[b]Also defined as "PIC," or products of incomplete combustion, in EPA's "Six-Month Study."[11] B(a)P is used as a surrogate for calculating risk and aggregate cancer incidence from PIC exposure in this study.

There are compounds which will be locally important in some areas which will not pose significant national risk. Acrylonitrile, 4,4-methylene dianiline and propylene oxide are examples of substances which may account for significant exposures in the proximity of a few larger chemical manufacturing plants, but which do not account for significant aggregate cancer incidence in the U.S.[11] Hence, the agency should not automatically exclude compounds from consideration because they are not on the above (or any or other) list. Since EPA continues to evaluate and list compounds for NESHAPS under Section 112 of the Clean Air Act, the agency may wish to include any newly listed compounds in its inventory, as well.

CHAPTER 5

SOURCE CATEGORY COVERAGE

For the most part, an agency must deal with the same types of sources and source categories in both criteria and air toxics inventories. The fundamental reason for this inherent similarity is that most air toxics are a subset of either particulate matter (PM) or volatile organic compounds (VOC); most toxic metals and heavy organics are emitted in the PM fraction while most toxic light organics are associated with the VOC fraction. For this reason, a complete criteria pollutant inventory will serve as a good starting point for the air toxics inventory.

Although most sources of air toxics should already be included in complete criteria pollutant inventories, every source will not emit toxic compounds. Table 10 presents a simplified source characterization scheme that may prove helpful in providing a broad perspective of what kinds of sources emit what air toxics. Table 10 summarizes available nationwide emission totals for the substances evaluated in EPA's "Six-Month Study."[11] The sources in Table 10 are lumped by similarity of operations, physical characteristics, mode of release, etc., into the following generic categories that account for a large fraction of air toxic emissions.

1. SOCMI (Synthetic organic chemical manufacturing industry)
2. Solvent evaporation (surface coating, degreasing, printing, etc.)
3. Stationary fuel combustion (boilers, internal combustion engines)
4. Metal processing (mining, refining, production of metals)
5. Mobile sources (automobiles, boats, planes, etc.)
6. Waste oil combustion
7. Other (incineration, in process fuel use, etc.)

Several characterizations can be made from Table 10 that may prove useful in understanding which compounds are generally associated with what sources:

-Roughly half of the 86 substances are largely emitted from SOCMI facilities, i.e., producers of synthetic organic chemicals; users of these chemicals as feed stocks; or facilities that produce these chemicals indirectly as contaminants or byproducts. Major emitting points within SOCMI include equipment leaks (from pumps, valves, compressors, etc.), storage and handling losses (loading, unloading and breathing losses from railroad cars, storage tanks, etc.) process vents (distillation towers and reactor processes), and secondary ad indirect sources (e.g., wastewater treatment).

-Solvent use accounts for the major release of a number of sub stances including cyclohexane, methyl ethyl ketone, chlorobenzene, nitrobenzene, perchloroethylene, trichloroethylene, methyl chloroform, cresols, acrolein, methylene chloride, and xylenes. Solvent loss occurs from evaporation during surface coating, degreasing, dry cleaning, printing, etc. Minor point and area sources are significant contributors.

-Metal processing includes emissions from mining, refining and the production of alloy and metal products. Emissions of zinc, manganese, copper, cadmium, nickel and beryllium are all significant. Although not explicitly identified with this category, chrome plating is a very important source of chromium emissions.

-Mobile sources are major emitters of benzene, toluene, isomers of xylene, POM and formaldehyde. Large percentages of all benzene, toluene, POM, and xylene emanate from mobile sources, primarily from tailpipe emissions and evaporation from gasoline powered vehicles.

-Stationary fuel combustion is the largest emitter of POM and several metals (beryllium, chromium and nickel) and an important source of chlorine, cadmium, copper, formaldehyde and manganese. Generally, smaller sources such as woodstoves will be the most important emitters of POM.

-Except for waste oil combustion, so-called "nontraditional sources" are not covered in Table 10. Nontraditional sources are those that have not traditionally been included in criteria pollutant inventories, but which may be significant emitters of air toxics. Potentially important nontraditional sources are listed below:

- Publicly-owned Treatment Works (POTWs), i.e., municipal sewage treatment plants.
- Treatment, Storage and Disposal Facilities (TSDFs) with handle hazardous waste in the following kinds of operations:
  - -landfills and land treatment
  - -surface impoundments and treatment tanks
  - -waste piles
  - -drum handling
  - -unloading and storage
  - -recycling
  - -deep well injection
  - -incineration
- Waste oil combustion
- Wood combustion (stoves, fireplaces)
- Drinking water aeration
- Cooling towers
- Hospital and medical supply sterilizers

-Methylene chloride and methyl chloroform (1,1,1-trichloroethane) are emitted in important quantities from solvent use, aerosols, etc., but may not be accounted for in VOC inventories that have been adjusted to remove non-photochemically reactive compounds.

It must be emphasized that Table 10 is based on fragmented and sometimes old, inconsistent data, since reliable air toxics emission estimates are only

slowly forthcoming. Hence, the conclusions drawn therefrom should not be considered absolute. Moreover, since the underlying data in Table 10 are representative of the entire nation, the proportions will not necessarily apply to any particular region or urban area -- especially for point sources. Nevertheless, the broad perspective offered by this summary may offer some help in the screening process in understanding and characterizing the general distribution of air toxics emissions.

TABLE 10

NATIONWIDE AIR TOXIC EMISSIONS BY BROAD SOURCE CATEGORY[22]

SUBSTANCE	PERCENT OF EMISSIONS BY EACH SOURCE CATEGORY								TOTAL EMISSIONS [a] (KKG/YR)	CONFIDENCE [b]
	SOCMI	SOLVENT USE	STATIONARY FUEL COMBUSTION	METAL PROCESSING	MOBILE	WASTE OIL COMBUSTION	OTHER	SOURCE OF OTHER		
Acetaldehyde	22.0	36.0	42.0		TR				1,782	C
Acetic acid	35.8		64.2						72,046	C
Acetonitrile	100.0								591	C
Acrolein	41.8	58.2							41.5	C
Acrylamide	97.4		2.6						3.8	B
Acrylonitrile	100.0								2,664	B
Allyl chloride	100.0								408	B
Ammonia	99.9		0.1		TR				110,109	C
Barium carbonate	100.0								160	C
Benzene	6.0				70.2	TR	23.8	coke ovens, gas marketing	118,145	A
Benzyl chloride	99.0								38	A
Beryllium			83.7	3.8	1.4	0.8	10.4	coke ovens	163	C
1,3-Butadiene	99.8						0.2	fungicide	4,737	C
Cadmium	10.0		23.7	65.6		0.6			475	B
Carbon disulfide	99.9								55,549	C
Carbonyl sulfide	100.0								23,423	C
Carbon tetrachloride	15.6	4.2					80.2	fumigant, lab use, storage and marketing	27,482	C
Chlorine	1.5		98.2				0.2	glass manufacturing, wood processing, brick kilns	615,972	C
Chloroacetic acid	100.0								24.9	C
Chlorobenzene	.8	99.2							79,720	C

[a]Note that emissions do not represent a particular year. Note also that these data are based on fragmented and sometimes old, inconsistent data, since reliable air toxics emission estimates are only slowly forthcoming. The proportions in this table will not necessarily apply to any particular region or urban area -- especially for point sources.

[b]A qualitative ranking where "A" represents best agreement among sources and "C" represents poor agreement or perhaps only one source for the estimate.

TABLE 10 (continued)

NATIONWIDE AIR TOXIC EMISSIONS BY BROAD SOURCE CATEGORY[22]

SUBSTANCE	PERCENT OF EMISSIONS BY EACH SOURCE CATEGORY								TOTAL EMISSIONS (KKG/YR)	CONFIDENCE SCORE
	SOCMI	SOLVENT USE	STATIONARY FUEL COMBUSTION	METAL PROCESSING	MOBILE	WASTE OIL COMBUSTION	OTHER	SOURCE OF OTHER		
Chloroethane	100.0								4,541	C
Chloroform	11.4	47.5					41.1	chlorination, wastewater	6,940	C
Chloroprene	100.0								838	C
Chromium			89.6	0.2		1.4	8.9	cement production, coke ovens	2,819	C
Coke oven emissions	100.0								NA	C
Copper			24.2	75.8					10,425	C
o-Cresol	20.9	60.8		9.1			9.2	disinfectant, cleaning compound	2,047	B
m-Cresol	11.1	68.3		10.2			10.3	disinfectant, cleaning compound	4,980	B
p-Cresol	9.9	69.3		10.4			10.4	disinfectant, cleaning compound	4,146	B
Cumene	100.0								879	C
Cyclohexane		100.0							428	C
Dibenzofuran							100.0	combustion and pyrolysis of chlorinated compounds	NA	C
1,2-Dibromoethane	100.0				TR				885	C
p-Dichlorobenzene	0.8						99.2	space deodorant, moth control	22,682	B
1,2-Dichloroethylene	100.0								46.9	C
Dimethyl nitrosamine	93.4						6.6		98	B
Dioctylphthalate	100.0								NA	C
Epichlorohydrin	100.0								217	B
Ethyl benzene	48.1					51.9			1.04	C
Ethylene	98.6		1.1		TR		0.3	artificial ripening of fruits and vegetables	209,524	C

TABLE 10 (continued)

NATIONWIDE AIR TOXIC EMISSIONS BY BROAD SOURCE CATEGORY[22]

SUBSTANCE	PERCENT OF EMISSIONS BY EACH SOURCE CATEGORY								TOTAL EMISSIONS (KKG/YR)	CONFIDENCE SCORE
	SOCMI	SOLVENT USE	STATIONARY FUEL COMBUSTION	METAL PROCESSING	MOBILE	WASTE OIL COMBUSTION	OTHER	SOURCE OF OTHER		
Ethylene dichloride	90.0	5.0			2.0		2.0	fumigant, pesticide, color film	64,800	C
Ethylene glycol	100.0								982	C
Ethylene glycol monoethyl ether	100.0								14.0	C
Ethylene oxide	31.3						68.7	fumigant, sterilant	5,680	B
Ethyl ester acrylic acid	100.0								203	C
Formaldehyde	49.9		17.5		32.6				570,000	C
Hexachlorocyclopentadiene	100.0								NA	B
Hexahydro-2h-azepin-1-one	100.0								4,221	C
Isopropyl alcohol	100.0								1,310	C
4,4-Isopropylidenediphenol	100.0								NA	C
Maleic anhydride	100.0								1,504	C
Manganese	1.8		15.8	76.2	TR		6.2	battery production, coke ovens	16,356	C
Melamine	100.0								NA	C
Methanol	98.6	1.4							23,582	C
Methyl chloroform	0.1	78.6					21.3	adhesives, aerosols, paint	212,774	A
Methyl chloride	100.0								23,982	B
Methylene chloride		56.1					43.6	aerosol, foam blowing	200,409	C
Methyl ethyl ketone		100.0			TR				5,317	C
4,4-Methylene-dianiline	100.0								26.1	C
Methyl methacrylate	100.0								728	C

TABLE 10 (continued)

NATIONWIDE AIR TOXIC EMISSIONS BY BROAD SOURCE CATEGORY[22]

SUBSTANCE	PERCENT OF EMISSIONS BY EACH SOURCE CATEGORY								TOTAL EMISSIONS (KKG/YR)	CONFIDENCE SCORE
	SOCMI	SOLVENT USE	STATIONARY FUEL COMBUSTION	METAL PROCESSING	MOBILE	WASTE OIL COMBUSTION	OTHER	SOURCE OF OTHER		
Napthalene	100.0								119.4	B
Nickel			84.1	7.3	8.0	0.1	0.1	coke ovens	10,182	B
Nitrobenzene	4.0	96.0							3,032	B
Nitrosomorpholine	0.2						99.8	corrosion inhibitor, polishes, optical brightener	4,558	B
Pentachlorophenol	11.9						88.1	fungicide, home and garden applications, preservative	101	B
Perchloroethylene	6.4	93.6				TR			144,083	A
Phenol	100.0				TR				2,406	C
Phosgene	100.0								91	B
Phthalic anhydride	100.0								1,059	C
Polychlorinated biphenyls							100.0	transformers, waste incineration	NA	C
Polycyclic organic matter			51.8		42.6		5.6	waste incineration, charcoal production, coke ovens	NA	C
Propene	100.0					TR			37,540	C
Propylene oxide	100.0								608	C
Styrene	100.0								5,625	C
Terephthalic acid	100.0								NA	C
Titanium dioxide							100.0	pigment use	4,278	C
1,2-Toluene diisocyanate	100.0								51.0	C
Toluene	37.1	0.1			61.6		1.0	coke ovens	1,013,379	C
Trichloroethylene	0.1	91.4				TR	8.5	adhesives, paint	85,917	A
Vinyl acetate	100.0								682	C

TABLE 10 (continued)

NATIONWIDE AIR TOXIC EMISSIONS BY BROAD SOURCE CATEGORY[22]

SUBSTANCE	PERCENT OF EMISSIONS BY EACH SOURCE CATEGORY								TOTAL EMISSIONS (KKG/YR)	CONFIDENCE SCORE
	SOCMI	SOLVENT USE	STATIONARY FUEL COMBUSTION	METAL PROCESSING	MOBILE	WASTE OIL COMBUSTION	OTHER	SOURCE OF OTHER		
Vinylidene chloride	100.0								67.0	C
o-Xylene	1.8	52.3			45.9				122,044	B
m-Xylene	0.8	54.0			45.2				206,152	B
p-Xylene	3.8	48.5			47.7				108,759	B
Zinc			3.7	96.3					55,572	C
Zinc oxide				1.7			98.3	pigment use	7,208	C

CHAPTER 6

POINT/AREA SOURCE DISTINCTIONS

Most emission inventories distinguish between point sources and area sources. Point sources are those sources large enough to permit and/or to keep individual records on. Area sources are sources too small and/or numerous to permit or to warrant individual recordkeeping. (Some inventories also distinguish between major point and minor point sources.) The rationale for making this distinction is to minimize the reporting burden on smaller sources and to reduce the volume of point source inventory records.

6.1 Making the Point/Area Source Distinction

The point/area source distinction can be made in several ways:

A. By defining all sources within particular source categories as either point or area sources. For example, all gasoline service stations, dry-cleaners, etc., might be handled as area sources and exempted from reporting, and, conversely, all hospital sterilizers and chrome platers may be required to submit emissions data as point sources.

B. By establishing emission cutoff or "de minimis" levels. For example, sources might only be required to report emissions greater than "x" tons per year.

Various de minimis levels and exemption criteria are presently being employed by States and local agencies in their air toxics inventories. Some of these are listed in Table 11 as examples. At least one agency has defined cutoff levels for each toxic substance covered in its inventory.

6.2 Factors Affecting the Point/Area Source Distinction

The agency needs to make several decisions regarding the point/area source distinction. For example, the point/area source distinctions for criteria pollutants need to be evaluated carefully if the agency plans to base the air toxics inventory on the criteria pollutant inventory. Small industrial sources such as dry cleaners, degreasers, chrome platers, paint coaters, waste oil boilers, etc., are often considered collectively as area sources in criteria pollutant inventories since their emissions of PM or VOC may not exceed typical cutoff levels of 5-100 tons per year. In some cases, these smaller sources may even be excluded altogether from the existing inventory and not even covered as area sources. If the agency decides that it needs to permit and keep individual records on certain of these smaller sources to afford a proper evaluation of emissions and risk, additional contacts may be necessary to obtain the necessary source and/or emissions data. Conceivably, the agency might even go to a "zero" emission cutoff level for a few important sources, thereby designating <u>all</u> sources within particular categories (e.g., all chrome platers or all benzene storage tanks) as point sources regardless of size, throughput or emissions.

The principal advantage of considering sources individually rather than collectively is that it results in more accurate estimates of emissions, ambient air concentrations and risks. It also improves the accuracy of any detailed control strategy projections. A negative aspect of considering many small sources as point sources is that more resources are required both by the agency and the industrial community to collect and digest the greater volume of point source data. In this regard, industry may strongly resist any requirements to acquire information on very small sources without some reporting exemptions based on emission rates and/or substance toxicities. Of course, if an agency is focusing on all sources within relatively small geographic areas, the added expense of considering small sources individually may be necessary.

One potential problem should be mentioned with using cutoff or de minimis levels in air toxics inventories, a problem that exists in criteria pollutant inventories, as well. If the cutoff level chosen allows a significant number of sources to escape consideration as point sources, these sources will have to be considered collectively as area sources if the agency is seeking a comprehensive emission inventory. For example, if the agency exempts coin-operated (self-service) dry cleaners and small, cold-cleaner degreasers from reporting, a significant amount of perchloroethylene, methylene chloride and methyl chloroform will not be inventoried unless these small emitters are accounted for in the area source totals. (Procedures for accounting for sources below cutoff levels as area sources are discussed in Reference 2.)

TABLE 11

EXAMPLE CUTOFF LEVELS AND EXEMPTED SOURCES

Example Cutoff Levels

- None
- 1 TPY of any toxic substance
- 100 TPY of any regulated pollutant
- 0.25 lb emission of any toxic substance per 8 hr time period
- Cutoff level for each inventoried compound (as function of TLV)

Examples of Exempted Sources

- Boilers <100 MMBtu/hr exempted
- Boilers firing wood or unadulterate fossil fuels
- Certain small sources exempted (e.g., dry cleaners, service stations)

CHAPTER 7

GEOGRAPHIC AREA OF COVERAGE

An important consideration during the screening process regards how big a geographic area should be covered. Typically, criteria pollutant inventories cover fairly board areas such as entire states or nonattainment areas. This extent of coverage has been necessary since criteria pollutants are ubiquitous and emitted by a diverse collection of point and area sources.

There are no well defined boundaries for air toxics inventories such as exist for nonattainment areas. Because inventorying a multitude of toxic substances can be expensive and time consuming, the relevant question is whether there are justifiable rationale for excluding certain areas from coverage in order to save resources. The answer to this question may be based on the underlying approach the agency has taken in its air toxics control program.

The most common approach in air toxics programs is to model ambient air levels around new and/or existing point sources, using source emission estimates, and then impose controls based on how much the modeled levels exceed some acceptable ambient standards or guidelines. Since the nature of this type of program is to focus solely on major point sources wherever they occur -- often regardless of the existence of other nearby sources -- the concept of excluding some areas from concern is really not germane as the entire State (or local jurisdiction) becomes the area of coverage. Thus, extent of coverage may not be an issue in this type of program.

In programs that are (1) defining relative emission strengths of small, non-permitted point sources and area sources, or (2) starting to consider the additive risks from these smaller sources along with major, permitted sources, the concept of limiting geographic coverage has more relevance. Several studies[11,23] have concluded that small sources are major contributors to aggregate incidence in urban areas; hence, this focus seems appropriate. However, due to the extra burden of compiling point source data on many smaller sources and developing area source emission estimates at an appropriate level of spatial resolution, it makes sense to try to limit the area of coverage to the extent justifiable.

This matter is an important one to consider during the planning stages of inventory development and one that a screening study can address. Those agencies that plan to compile more than a crude, aggregate inventory of small point and area sources -- especially those agencies concerned with additive risk assessments and control strategy evaluations based on risk management techniques -- should predetermine where to focus their inventory effort. Presumably, such emphasis would be placed on industrial and/or urban areas, or high risk areas therein, where the screening study indicated high emission concentrations and/or high ambient air levels along with elevated risks.

CHAPTER 8

DETAILED DATA COLLECTION AND EMISSION ESTIMATION PROCEDURES

Chapter 3 discussed the concept of the screening inventory as a means of locating potential emitters of air toxics and developing screening estimates of emissions. The purpose of the screening study is to focus subsequent agency activities and resources on those sources, pollutants and geographic areas causing most risk. At some point in the air toxics program, the screening inventory will probably need to be refined before any control program is instituted. During this follow-up effort, more detailed and credible source data and emissions estimates will be needed, probably requiring some direct source contacts to provide this information. Various procedures are set forth in this report to help those agencies going beyond the screening inventory. In this regard, some of the approaches for compiling the detailed inventory will be the same as or extensions of those used for screening. For example, the location of sources will largely be the same, using the basic tools outlined in Chapter 3. The major differences are in compiling detailed source data and making emission estimates.

8.1 Locating Sources

Since most sources of air toxics substances should already be in the criteria pollutant inventory, these sources should not have to be located again as if the agency were starting from scratch. Instead, the agency needs only to associate emissions of specific air toxic compounds of interest with existing sources in the existing inventory. As mentioned before, certain "nontraditional" sources may not be included and certain sources may be excluded because their VOC were considered photochemically nonreactive. Two important nonreactive VOC of particular interest are methyl chloroform (1,1,1 trichloromethane) and methylene chloride.

Many of the screening tools outlined in Chapter 3 will be appropriate for use in locating sources in the detailed inventory and, thus, are not repeated here. Since none of these screening tools requires source contacts, some errors will occur in identifying actual emitters of particular toxic substances. One additional locating tool that some agencies employ that involves making source contacts is the production/use survey. Some agencies have utilized production/use questionnaires which basically just ask sources to identify whether each substance is purchased, used or produced. From this, the agency may decide which facilities should receive a more detailed, followup questionnaire.

In general, the emphasis in the detailed inventory will not be on locating sources, since this has presumably been done in the screening process. This step will be necessary, however, where the agency has foregone the screening process.

8.2 Data Collection

Before sending out questionnaires or making plant visits, the agency should carefully evaluate the need to contact all sources. Based on the results of the screening study, certain sources may have such low emissions or pose such little risk that further information would not prove useful. Or, in some cases, the screening estimate developed by the agency based on material balances or emission factors may prove as accurate as any estimates likely to be provided by certain industrial segments. The latter may be the case for small solvent users and combustion sources. For those sources where the agency believes it needs more information, data collection may proceed using questionnaires, plant visits, etc., just as with any criteria pollutant. A great deal of data can also be obtained through the new source review and permit renewal process.

A. Use of Questionnaires

As mentioned previously, a fundamental decision that has to be made during planning is whether the questionnaires should be open-ended or directed toward a limited number of compounds. This decision will affect both the design of the questionnaires and the nature of data collected. In general, if a directed approach is taken, and the number of compounds is kept to a minimum, the resulting number of source contacts that has to be made can be greatly reduced. Moreover, the quality of the data received may also improve -- especially if the questionnaires can be tailored to the principal source categories of concern. Data collected from industry-specific questionnaires will not only be more accurate for the respondent sources themselves, but will also allow the agency to develop emission factors and emission-to-employee ratios to apply to other, perhaps nonresponding, sources in the same source categories. Of course, tailoring questionnaires to specific industries can be costly and time consuming unless another agency's questionnaires can be adopted. This time and effort may be recovered since less followup will often be required.

Conversely, if one uses the open-ended approach and is not targeting information on specific sources or a limited group of compounds, a much larger number of contacts will be necessary using questionnaires that are more generic in design. This approach may require less time and effort for questionnaire design, but the resulting responses may be commensurately less detailed and possibly not as useful. For example, if an agency is conducting an open-ended survey of air toxics associated with solvent use, a fairly general survey form will have to be sent out to a large number of coaters, degreasers, printers, drycleaners, etc., with a voluminous and varied response expected. As mentioned previously, a particular danger in this type of survey is that many (especially smaller) sources may simply report trade names of solvents, coatings, etc., or may not report anything at all if they don't know what compounds are present in the materials they use. Either possibility can lead to under reporting and an underestimating of substance use and emissions by the sources and the inventory agency. Various kinds of questionnaires have been developed to collect air toxics emissions data, with some being quite detailed and others being very general. EPA has developed a document,

Compilation Of Air Toxics Emission Inventory Questionnaires (EPA-450/4-88-008).[24] This document provides a resource for agencies interested in developing air toxics emission inventory mail out questionnaires. The questionnaires represent various formats dependent on planned use of data and the agency's air toxic program.

B. Interpreting and Augmenting Questionnaire Responses

Whatever questionnaire is used, some responses will be incomplete and/or suspect. To this end, several other avenues may be explored to corroborate, complement or help interpret the questionnaire responses. For example, if the questionnaire respondent does not know the makeup of its company's emissions, it may pay to contact his purchasing department to see if any composition data can be inferred from purchasing specifications. Or, if Material Safety Data Sheets are available, they might be solicited in the data collection effort as they list specific compounds and weight percentages of hazardous ingredients present in coatings, paints, preservatives, thinners, resins, etc. Figure 1 shows an example Material Safety Data Sheet. This kind of information should be more available with time as a result of State and Federal right-to-know laws which require that information be made available on the composition of products being used in the work place. Specifically, as of May 25, 1986, OSHA's Hazard Communication, or right-to-know, standard requires users, distributors, repackagers, producers, importers, etc., (within SICs 20-39) to supply all known hazard data, including species composition data and some toxicity data, on Material Safety Data Sheets.[25]

State OSHAs can also be a valuable source of information even though the Federal Hazard Communication standard supersedes States' right-to-know laws. For example, some State agencies may have collected work place ambient air samples that could suggest what air toxics are being emitted. Also, these agencies may have information on compositions of trade name products.

Various published product indexes and formularies contain information product compositions that could assist in this regard. The Colour Index,[26] Pesticide Index,[27] and Formulary of Paints and Other Coatings[28] are examples of compilations of the makeup of products in certain industrial segments that may help the agency corroborate or interpret the questionnaire responses. Other publications that may be consulted for this kind of information are cited in References 29 through 32.

Finally, the National Institute for Occupational Safety and Health (NIOSH) has compiled an extensive data base containing information on the chemical composition of approximately 75,000 products from all segments of industry and commerce. This data base, called the Trade Name Ingredient Clarification File (TNIC) file, was developed by NIOSH under its National Occupational Hazard Survey from 1972-1974, and contains data on both metals and organics that were obtained by NIOSH visits to the various product manufacturers. There is no report, per se, summarizing the information in this file, but NIOSH personnel will develop appropriate retrievals upon request. Any prospective user should contact the Chief of the Hazard Section at NIOSH at (513) 841-4491 or (FTS) 684-4491. It should be noted that about one-third of the product data in the

FIGURE 1

SAMPLE MATERIAL SAFETY DATA SHEET

MATERIAL SAFETY DATA SHEET

FOR COATINGS, RESINS AND RELATED MATERIALS

DATE OF PREP 4-19-82

Section I

PRODUCT CLASS: Epoxy

TRADE NAME: Devran

MANUFACTURERS CODE IDENTIFICATION: Formula 201

Section II — HAZARDOUS INGREDIENTS

INGREDIENT	PERCENT	TLV PPM	TLV MG/M³	LBS.	VAPOR PRESSURE
Methyl n-Amyl Ketone	10	100		1.11	2.6
n-Butyl Alcohol	15	100		1.4	5.5
Xylol	10	100		1.1	6
n-Butyl Acetate	5	200		1.7	8

Section III — PHYSICAL DATA

BOILING RANGE: 210 - 305°F

VAPOR DENSITY: [I] HEAVIER; [ ] LIGHTER, THAN AIR

EVAPORATION RATE: [ ] FASTER; [I] SLOWER THAN ETHER

PERCENT VOLATILE BY VOLUME: 59%

WEIGHT PER GALLON: 11#

Section IV — FIRE AND EXPLOSION HAZARD DATA

FLAMMABILITY CLASSIFICATION: OSHA 29 CFR 1910.106(a) Para 18-19
Liquid Class IC Flammable Liquid

FLASH POINT: Over 80°F Pensky-Martens Closed Cup

USE: See Section II -

EXTINGUISHING MEDIA

CO_2, Dry Chemical, Foam or other National Fire Protection Association (NFPA) approved method for treating a Class B fire.

SPECIAL FIRE AND EXPLOSION HAZARDS

Due to pressure build-up, closed containers exposed to extreme heat may explode. Never use a welding or cutting torch on or near container (even empty) as product or its residue may ignite.

SPECIAL FIRE FIGHTING PROCEDURES

Where possible, isolate containers from heat, electrical equipment, sparks and flame.
Use full protective equipment including self-contained breathing apparatus.
Water spray may be ineffective. If water is used, fog nozzles are preferable.
If exposed to fire or extreme heat, water should be used to cool closed containers and prevent pressure build-up or possible auto-ignition.

NOTE: Companies are allowed to use any reporting format as long as the necessary data are contained. Hence, differing formats would be expected from most companies.

TNIC file is considered confidential and therefore unavailable. NIOSH repeated this survey in 1981-83 on an expanded list of products. These data base may prove useful in matching possible pollutants with sources if more direct procedures are not successful.

Synonyms for commonly inventoried substances are presented in Appendix C.

C. Use of Information in Permit Applications

Many agencies have new source review and permit renewal programs that cover air toxics. These activities should be viewed as a potential source of information for use in the air toxics emission inventory. Some agencies directly incorporate certain permit conditions, such as allowable emissions, in the emission inventory.

The permit process should be viewed as a good way to collect air toxics information because of the leverage the agency has on the permit applicant. However, because the duration of many States' permit renewal cycle is typically from 3 to 5 years, the agency normally cannot use this process to develop or update the air toxics inventory quickly.

8.3 Emission Estimation Procedures

Air toxics emissions are estimated in largely the same manner as are criteria pollutant emission estimates. The two main approaches involve the use of emission factors and material balances. The use of speciation factors, as described in Chapter 3, is generally considered more of a screening tool although it may also find some application in the detailed inventory. Source testing is another procedure that may be applicable in certain situations.

Currently, the literature contains limited information on air toxic emission factors for various substances. The main source is the EPA series entitled Locating And Estimating Air Emissions From Sources Of (Substance) and the Toxic Air Pollutant Emission Factors - A Compilation For Selected Air Toxic Compounds And Sources. (See Table 5 in Chapter 3).

Another potential source of emission factor information is EPA's National Air Toxics Clearinghouse data base.[12] States and local agencies have submitted permit and source test information to the Clearinghouse that may be of assistance in determining emission rates for many kinds of industrial facilities. Contact names and phone numbers are also given, allowing the user the opportunity to get more information directly from the supplying agency. As more data are supplied, the Clearinghouse should improve as a source of emissions data.

The second major technique for estimating air toxics emissions is the material balance. In a material balance, emissions are determined by difference by knowing the amount of a certain material that enters a process and the amount that (1) leaves either in liquid or solid waste, (2) is contained as part of a product, (3) is sold to a recovery facility or (4) is converted to another substance. Material balance techniques are particularly useful for

operations using solvents, but can also be used for metals, as well. Frequently, when doing a material balance for screening purposes, the conservative and simplifying assumption is made that all or some fraction of a solvent or metal used or consumed in a process is emitted to the air. Of course, any such conservative screening estimates may have to be refined later in the program if the inventory is going to be used for modeling or control strategy development purposes.

Source testing -- either by the agency or by the source itself -- represents a third technique for estimating air toxics emissions from a source. While source tests are generally considered to yield more accurate emission estimates than emission factors, they are not as widely employed for air toxics for several reasons. First, as with criteria pollutants, is the cost factor; source testing can be expensive. Second, validated sampling and analytical procedures are not yet readily available for many air toxics. Third, there are many situations where emission factors and material balance procedures will yield acceptable results at much less cost. Finally, there are certain sources which are not readily amenable to routine source testing, such as fugitive leaks from valves, pumps, etc., and certain intermittent operations characterized by varying flow characteristics and concentrations. Available source test methods are summarized in the Locating and Estimating -- documents for each respective substance. Other methods may be cited in Reference 8.

The use of emission factors and material balances for estimating air toxic emissions is exemplified in Appendix A.

8.4 Control Device Applicability and Efficiency

An important consideration when calculating current emission levels, as well as when projecting emission reductions, is control device applicability. EPA has published a manual which should help agency personnel select and evaluate costs of control techniques for reducing air toxics from industrial and commercial sources.[33] A generic treatment is given both to pollutants and sources. Air toxics are categorized and handled as (1) organic vapors, (2) organic particulate (3) inorganic vapors (4) inorganic particulate. Emission sources are classified as (1) process point sources, (2) process fugitive sources and (3) area fugitive sources. General guidelines are provided that match specific control devices with specified emission stream properties (e.g., pollutant content in stream, temperature, moisture, heat content, particle size and flow rate.) Basic design parameters are then determined to provide general design conditions that should be met or exceeded for each selected control technique to achieve some specified level of control efficiency. This manual can also identify which control techniques will not meet specified reduction requirements.

8.5 Problems in Data Collection and Interpretation

The agency may encounter problems in a number of areas when compiling the air toxics inventory. Some potential problem areas are identified below.

A. Too Many Substances

If the agency utilizes the open ended approach (discussed in Section 4.1) and does not limit the number of substances, it may receive much more information than it can adequately process and store in its data handling system. Also, it may encounter source reluctance to report on a large number of substances.

B. No Cutoff Levels or Exemptions

Many agencies employ cutoff levels to preclude reporting of low emission rates and/or exemptions to preclude reporting by certain sources. (See Chapter 6.) If an agency does not provide for any such exclusion, it runs the same risks as if it is trying to handle too many substances -- it may obtain more data than it can efficiently handle and it may encounter source resistance to reporting low emission levels for many substances.

C. Nomenclature Problems

Sources may report trade names or chemical synonyms that the agency may have difficulty in interpreting. In some cases, the composition of trade name products can be ascertained from the source or supplier by soliciting Material Safety Data Sheets; however, this is not always successful and such followup requires additional resources. Some of this can be avoided if the agency asks sources to report in terms of specific substances.

D. Sources Can't Supply Emissions Data

Some sources, for various reasons, may claim not to be able to supply the agency with adequate emissions data. This may particularly be the case with smaller operations that may not have the expertise or resources to determine emissions. Such determinations may even prove difficult for some large, complicated manufacturing processes. The agency will want to consider what services, if any, it may provide to such sources, or if it will make emission estimates itself.

E. Need for Agency Followup

Several agencies have pointed out the inevitable need for followup to clarify the responses from some sources or to obtain additional or missing data. This might be the case, for example, where the agency's screening estimates for a large source differ significantly from those supplied by the source, or where the agency believes a source is emitting a certain pollutant it doesn't report. The agency will probably want to hold some resources in reserve to make follow-up contacts to a fraction of its sources.

8.6 Source of Inventory Error

As in criteria pollutant inventories, the potential exists for many sources of error in the inventory of air toxics. Some of these errors will originate with the sources supplying the data and some will be a result of the data and methods used by the agency to estimate emissions. A summary of some of these errors is given below:

- Missing sources.
- Inaccurate/insufficient/uninterpretable data supplied by sources.
- Missing or inaccurate emission factors.
- Missing or inaccurate VOC and/or particulate matter apportioning factors.
- Erroneous material balance or source tests.

A number of corrective measures that may be employed to reduce these errors is summarized below:

- Perform followup visits, calls, and tests at important sources.
- Checks for missing sources.
  - -Apply pollutant/source category cross indexes to criteria pollutant inventories to identify potential sources.
  - -Check EPA emission factor and source assessment reports.
  - -Check permit, registration, compliance, right-to-know and other State or local data bases.
- Check EPA publications and the EPA National Air Toxics Clearinghouse for better emission factors and apportioning factors, or develop such based on emissions data submitted for similar sources.
- Review material balance and source test data, making sure that all material pathways have been identified, the best test procedures have been used and the results are reconcilable with estimates based on emission factors and/or VOC or PM speciation factors.

It is very difficult to develop rigorous, quantitative estimates of the precision and accuracy of emission inventories because many of the components are not amenable to mathematical error analysis. The best means to minimize error is to use the best data and procedures possible, within existing resources, and to subject the results to review by those that will either use the data or be affected by subsequent application thereof.

CHAPTER 9

SUMMARY

Many State and local agencies have compiled inventories of air toxic emissions or are starting to develop them. Several different directions are being taken in the design of these inventories as well as in how they are being used in the agencies' source evaluation and control programs. Because these inventories can be expensive due to the large number of pollutants that potentially can be included, careful planning is necessary -- before initiating any data collection -- to optimize the use of available resources. In this regard, all end uses of the inventories should be identified during the planning stages, realizing that the most demanding modeling and risk assessment applications will dictate how detailed and extensive the inventories must be.

If possible, some type of screening study might be performed to focus the inventory on those pollutants, sources and geographic areas that pose the greatest risk. Various tools are available to compile preliminary inventories for screening purposes without having to make extensive source contacts. These tools include EPA published emission factors, speciation factors and source assessment documents along with existing criteria pollutant emission inventories and permit files. Federal and State right-to-know standards may also result in useful information for this purpose.

The detailed emission inventory of air toxics is compiled using the same basic techniques employed in criteria pollutant inventories. Many agencies are, in fact, directly coupling their air toxics inventory activities with their criteria pollutant programs. The data in the criteria pollutant inventory and permit system can serve as a useful starting point for developing the detailed air toxics inventory, either to help locate potential sources of air toxics or to make emission estimates therefrom. For less important sources, the agency may not need to go beyond the preliminary emission estimates made in the screening inventory; however, for more important sources, questionnaires or other direct source contacts may be necessary to determine emissions. The mechanics of making source contacts and determining emissions will be largely the same as the criteria pollutant inventory.

Most sources of air toxics will already have been inventoried as part of particulate or VOC programs. Additional emphasis will be needed to include non-traditional sources, sources below the criteria pollutant cutoff level(s), and sources of photochemically nonreactive compounds (particularly methylene chloride and methyl chloroform.) And further spatial or temporal resolution may be needed in the air toxics inventory for certain area sources than is afforded in the criteria pollutant inventory.

REFERENCES

1. Statement of Lee M. Thomas, Administrator, U.S. Environmental Protection Agency, before the Subcommittee on Health and the Environment Committee on Energy and Commerce, U.S. House of Representative, June 11, 1985.

2. Procedures for the Preparation of Emission Inventories for Precursors of Ozone, Volume 1, EPA-450/4-88-021, Third Edition, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1988.

3. Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds. Volume II: Emissions Inventory Requirements for Photochemical Air Quality Simulation Models. EPA-450/4-79-018. U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1979.

4. Procedures for Emission Inventory Preparation, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC:

   a. Volume I: Emission Inventory Fundamentals, EPA-450/4-81-026a, September 1981.

   b. Volume II: Point Sources, EPA-450/4-81-026b, September 1981.

   c. Volume III: Area Sources, EPA-450/4-81-026c, September 1981.

   d. Volume IV: Mobile Sources, EPA-450/4-81-026d (Revised), July 1989.

   e. Volume V: Bibliography, EPA-450/4-81-026e, September 1981.

5. Example Emission Inventory Documentation for Post-1987 Ozone State Implementation Plans (SIPS), EPA-450/4-89-018. U.S. Environmental Protection Agency, Research Triangle Park, NC, October 1989.

6. Development of Questionnaires for Various Emission Inventory Uses. EPA-450/3-78-122. U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1979.

7. Development of an Emission Inventory Quality Assurance Program. EPA-450/4-79-006. U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

8. Bibliography of Selected EPA Reports and Federal Register Notices Related to Air Toxics, U.S. Environmental Protection Agency, Research Triangle Park, NC:

   a. Volume 1: Citations, EPA-450/5-87-005, NTIS PB 88-136601, July 1987.

b. Volume 2: Citations, EPA-450/5-88-005, NTIS PB 89-103436/AS, July 1988.

c. Volume 3: Citations, EPA-450/3-89-25, NTIS PB 90-1135/AS, July 1989.

d. Index: EPA-450/3-89-25a, NTIS PB 90-113423/AS, July 1989.

9. A Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants, EPA-450/4-88-009, NTIS PB 89-134340, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

10. Guideline on Air Quality Models (Revised) and Supplement A, EPA-450/2-78-027R, NTIS PB 86-245248, PB 88-150958, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986 and July 1987.

11. Haemisegger, E., et al., The Air Toxics Problem in the United States: An Analyses of Cancer Risks from Selected Pollutants, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1985.

12. NATICH Data Base Report on State, Local and EPA Air Toxics Activities, U.S. Environmental Protection Agency and STAPPA/ALAPCO, EPA-450/3-89-29, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1989.

13. Air Emission Species Manual, EPA-450/2-88-003a and b. NTIS PB 88-225792, PB 88-225,300, U.S. Environmental Protection Agency, Research Triangle Park, NC, April 1988.

14. Survey of Ethylene Dichloride Emission Sources, EPA-450/3-84-018, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1984.

15. Survey of Methylene Chloride Emission Sources, EPA-450/3-85-015, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1985.

16. Survey of Carbon Tetrachloride Emission Sources, EPA-450/3-85-018, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1985.

17. Survey of Trichloroethylene Emission Sources, EPA-450/3-85-021, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1985.

18. Survey of Chloroform Emission Sources, EPA-450/3-85-026, U.S. Environmental Protection Agency, Research Triangle Park, NC, October 1985.

19. Survey of Perchloroethylene Emission Sources, EPA-450/3-85-017, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1985.

20. A Preliminary Exposure and Preliminary Risk Appraisal for 35 U. S. Counties. Prepared for U.S. Environmental Protection Agency under Contract Number 68-01-6715 by Versar, Inc., and American Management Systems, September 1984.

21. Methods for Pollutant Selection and Prioritization, EPA-450/5-86-010, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

22. Lahre, Thomas F., "Characterization of Available Nationwide Air Toxics Emissions Data." U.S. Environmental Protection Agency, Research Triangle Park, NC, June 13, 1984. (Unpublished).

23. Air Toxics Controllability Study, Prepared for U.S. Environmental Protection Agency by E. H. Pechan & Associates, Inc. and Radian Corporation under Contract Number 68-01-7047, Work Assignment Number 26, October 1985.

24. Compilation of Air Toxics Emission Inventory Questionnaires, EPA-450/4-88-008, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1988.

25. "Hazard Communication," Final Rule. Federal Register, Volume 48, Number 228, Friday, November 25, 1983, pp. 53280-53348.

26. Colour Index, Third Edition, Society of Dryers and Colourists, American Association of Textile Chemists and Colourists. Bradford, West Yorkshire, 1982.

27. Wiswesser, W.J., Pesticide Index, 5th Edition, Entomological Society of America, College Park, Maryland, 1976.

28. Ash, M. and I. Ash, Formulary of Paints and Other Coatings, Volume 1, New York, NY, Chemical Publishing Company, 1978.

29. Merck Index: An Encyclopedia of Chemicals and Drugs, Ninth Edition, March 1976, Rahway, NJ.

30. Handbook of Chemical Synonyms and Trade Names, Eight Edition, Edited by Edward I. Cooke, CRC Press, 1978.

31. Condensed Chemical Dictionary, Tenth Edition, Gessner Hawley, Edited by Van NosReinhold, 1981.

32. Clinical Toxicology of Commercial Products, Fifth Edition, Robert E. Gesselin. Williams and Wilkins, 1984.

33. Evaluation of Control Technologies for Hazardous Air Pollutants, EPA-625/6-86-011a, U.S. Environmental Protection Agency, Research Triangle Park, NC, February 1986.

APPENDIX A

EXAMPLE APPLICATIONS OF SCREENING TOOLS

APPENDIX A

EXAMPLE APPLICATIONS OF SCREENING TOOLS

Examples of each of the screening tools discussed in Chapter 3 of this report and how they can be applied are given in Appendix A. The screening tools described are:

- -SIC/pollutant, pollutant/SIC crosswalk
- -Emission factors
- -Speciation/apportioning factors
- -Conservative mass balance

The strengths and limitations of each tool as related to air toxics emission inventory development and permitting/new source review are discussed. For either of these applications, the objectives of using a screening tool are:

- -To identify potential toxic air pollutants associated with a source category;
- -To estimate the quantity of air toxics emissions; and
- -To focus or direct follow-up, detailed analyses.

Using combinations of each of the four types of screening tools can allow State/local agencies to reach these three objectives.

A.1 USE OF SIC/POLLUTANT CROSSWALK INDICES

In this section, uses of the SIC/pollutant crosswalk indices are discussed. While the crosswalk provide an indication of the pollutants reasonably anticipated to be associated with a given SIC code, they do not provide definite proof that the pollutants are emitted. One limitation of using the SIC pollutant crosswalk indices is that any given source may emit one, all, or none of the pollutants listed in the index. A source may emit other pollutants not covered in the Toxic Air Pollutant/Source Crosswalk document or not permitted by reporting agencies. An example is provided.

Example: Identification of a Potential Emitted of Air Toxic

A state air pollution control agency needs to evaluate which toxic pollutants are emitted in the state.

As a first step, the agency could identify the source categories the area of concern by SIC code: for example, a gray and ductile iron foundry - SIC. 3321. The existence of this source may have been

TABLE A-1

SIC	SIC CODE DESCRIPTION	SCC CODE	ASSOCIATED POLLUTANTS
3321	Gray and Ductile Iron Iron Foundaries		Acetaldehyde (21, 22, 23, 28, 29) Acetone (21, 22, 27, 28) Acrolein (21, 22, 23, 24, 28, 29) Aluminum (21, 22, 27, 28) Aluminum Oxide (27) Ammonia (21, 22, 23, 27, 29) Aniline (21, 22, 28) Antimony (27) Arsenic (20, 21, 23, 27, 29) Asbestos (27) Barium (27) Benzene (21, 22, 23, 24, 27, 28, 29) Benzene, Ethyl- (27) 1,2,4-Benzenetricarboxylic Acid 1,2-Anhydride (28) Beryllium (21, 23, 29) Biphenyls Polychlorinated (PCBS) (27) 1-Butanol (27) Butyl Acetate (22) Cadmium (20, 21, 22, 27, 29) Chlorine (27) Chloroform (23) Chlorophenols (21, 24, 27, 28) Chromic Acid (VI) (22) Chromium (20, 21, 22, 23, 27, 29) Cobalt (27) Copper (21, 22, 23, 26, 27, 29) Corticosterone (28) Cumene (27) Dibutyl Phthalate (27) 1,2-Dichloroethylene (28) Diethanaolamine (27) Dimethyl Phthalate (27) Dioxins, Polychlorinated Dibenzo-P-, Total (27) Dioxins, Polychlorinated, Total (27) Diphenylmethanediisocyanate, 4,4'- (27) Ethane, Dichlorotetrafluoro (28) Ethane, 1,1,1-Trichloro (21, 22, 23, 27, 28, 29) Ethane, 1,1,2-Trichloro (27) Ethanol, 2-Ethoxy- (27) Ethylene Glycol (27) Formaldehyde (21, 22, 23, 24, 27, 28, 29)
	Iron Foundaries		

TABLE A-1 (continued)

SIC	SIC CODE DESCRIPTION	SCC CODE	ASSOCIATED POLLUTANTS
3321	Gray and Ductile Iron		Furan, 1,2,3,4,7,8-Hexachloro-dibenzo- (28) Furan, 1,2,3,6,7,8-Hexachloro-dibenzo- (27) Furan, 1,2,3,7,8,9-Hexachloro-dibenzo-(27) Furfuryl Alcohol (22) Hydrogen Cyanide (21, 22, 28) Hydrogen Sulfide (21, 22, 23, 29) Iron (22) Isobutyl Alcohol (22) Isopropanol (27) Lead (21, 23, 27, 29) Manganese (21, 23, 26, 27, 29) Mercury (3) Methanol (27) Methylene Chloride (27) Methyl Ethyl Ketone (21, 22, 27) Methyl Isobutyl Ketone (27) Naphthalene (21, 22, 23, 24, 27, 28, 29) Nickel (20, 21, 22, 23, 27, 29) 1-Nonene (28) Phenol (22, 22, 23, 24, 27, 28) Phenol, 2,4-Dimethyl (28) Phosphoric Acid (27) Phthalate, Diisooctyl (29) Polycyclic Organic Matter (3) Polyvinyl Chloride Latex (28) Propane, 1,2,3-Trichloro- (29) Saccharin (27) Silica, Crystalline - Quartz (22) Silicon Carbide (22) Sodium Hydroxide (27) Styrene (21, 22, 23, 29) Sulfuric Acid (27) Tetrachloroethylene (27) Toluene (21, 22, 23, 24, 27, 28, 29) Trichloroethylene (27) Uranium (22) Vanadium (27) Xylene, M- (21, 23, 24, 27) Xylene, O- (21, 23, 24) Xylenes (Mixed Isomers) (27, 29) Xylidine (29) Zinc (21, 11, 23, 27, 28, 29)

determined from an existing criteria pollutant inventory or permit/registration file. The SIC/pollutant crosswalk document (Table A-1) shows 79 pollutants potentially associated with SIC 3321. Based on this information, the agency could decide to inventory and further investigate these pollutants.

Conversely, a pollutant/SIC index can be used to identify potential emitters of particularly toxics. For example, if an agency were interested in acetaldehyde, there are 50 potential source categories associated with potentially emit acetaldehyde (see Table A-2).

TABLE A-2

Acenaphthene	2431, 2491, 2752, 2759, 2812, 2821, 2833, 2842, 2865, 2869, 3089, 3411, 3471, 3663, 3721, 3728, 4952, 8731, 9223, 9711
Acenaphthylene	2491
Acephenanthrylene, Benz(E)-	2491, 25 , 251 , 252 , 253
Acetaldehyde	2013, 2087, 2095, 2099, 2297, 2421, 2429, 2431, 2435, 2436, 2621, 265 , 2656, 267 , 2673, 2674, 2812, 2819, 2821, 2822, 2823, 2824, 2844, 2851, 2865, 2869, 287 , 2873, 2879, 2891, 2892, 2899, 2911, 2951, 308 , 32 , 3312, 3321, 3479, 3679, 3826, 3827, 3829, 3861, 4911, 4953, 516 , 6512, 8059, 8062
Acetaldehyde, Chloro-	07 , 2869
Acetaldehyde, Diethyl Acetal	2844
Acetamide	2819, 2821, 2833, 2842, 2865, 2869, 3479, 3674
Acetamide, Methyl-N-([methylcarbamoyl)oxy]thio-	5153
Acetamide, N-9H-Fluoren-2-Yl	289 , 3861
Acetamide, N,N-Dimethyl-	2819, 2821, 308 , 3585, 3861
Acetanilide	2851, 2865, 3411
Acetanilide, 2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)-	2431, 2879, 308 , 3524, 3731
Acetate, 2-Butoxyethyl-	2869, 308 , 3241, 3312, 3484, 3585, 3629, 3641, 3821
Acetate, Ethyl Chloro-	2865, 2869, 2879
Acetate, Ethyl Cyano-	2833, 2865, 2869

A.2 USE OF EMISSION FACTOR LISTING

When source - specific data are not available for a facility, emission factors are useful tools for making emission estimates. Emission factors may also be used to cross check data submitted by a source during the permitting process. As pointed out in Chapter 3, the major sources of toxic emission factors are the "Locating and Estimating.... series" and the Air Toxics Emission Factor Compilation documents (see Table 4 in Chapter 3).

Example: Preparation of An Air Toxics Emission Estimate

Suppose an agency has decided to prepare a quick, preliminary estimate of cadmium emissions from municipal waste combustors. To illustrate the use of emissions factors for this source category, Table A-3 from the compilation document shows emission factors for this type of combustors. In order to calculate an emissions estimate, additional information is needed (e.g., type of combustor and kilograms of refuse burned per year). Such data may already exist in a permit file or from inspection reports. If not, an inquiry made to the facility or facilities or a site inspection may be needed. Assume there are two combustors in the area of concern, one a mass burn water wall facility burning 2,100,000 kilograms per year and, a mass burn refractory unit burning 800,000 kilograms per year. The estimated emissions are:

Cadium Emissions = 686 mg/kg x 2,100,000 kg/yr + 1228 mg/kg x 1,500,00 kg/yr

Cadium Emissions = $1440 \times 10^6 + 1842 \times 10^6$

Cadium Emissions = 3282×10^6 mg/yr or 3282 kg/yr

TABLE A-3

POLLUTANT	CAS NUMBER	SIC CODE	INDUSTRIAL PROCESS	EMISSION SOURCE	SCC	EMISSION FACTOR	NOTES	REFERENCE
Cadmium	7440439	3341	Secondary lead smelting	Reverberatory furnace	30400402	1.6 x 10E-6 lb/ton Pb	Controlled with cyclone + baghouse stack sampling + engineering estimate	38
Cadmium	7440439	3341	Secondary lead smelting	Reverberatory furnace	30400402	5 x 10E-7 lb/ton Pb	Controlled with three cyclones and baghouse	38
Cadmium	7440439	3341	Secondary lead smelting	Blast furnace	30400403	2 x 10E-6 lb/ton Pb	Controlled with three cyclones + baghouse stack sampling + engineering estimate	38
Cadmium	7440439	3341	Secondary zinc production	Total emissions	304008	1 x 10E-2 lb/ton Zn produced	Uncontrolled	38
Cadmium	7440439	3471	Electroplating	Plating tank		5.0 x 10E-5 g/hr/amp	Uncontrolled	147
Cadmium	7440439	3471	Electroplating	Entire process		0.00005 g/hr/amp	Uncontrolled, measured	92
Cadmium	7440439	3691	Nickel-cadmium battery manufacture	Total emissions	304005	2 lb/ton Cd charged	Survey of companies	38
Cadmium	7440439	4953	Municipal waste combustion	Mass burn, water wall facility	501001	686 mg/kg controlled particulate emis.	Controlled by ESP, based on source tests	118
Cadmium	7440439	4953	Municipal waste combustion	Mass burn, refractory facility	501001	1228 mg/kg controlled particulate emis.	Controlled by ESP, based on source tests	118
Cadmium	7440439	4953	Municipal waste combustion	Refuse-derived fuel facility	501001	106 mg/kg controlled particulate emis.	Controlled by ESP, based on source test	118
Cadmium	7440439	4953	Municipal waste combustion	Modular facility	501001	3310 mg/kg controlled particulate emis.	Controlled by ESP, based on source tests	118
Cadmium	7440439	4953	Municipal waste combustion	Incinerator stack	501001	0.004 kg/Mg munic. solid waste (dry wt.)	Controlled by spray-baffle scrubber, based on material balance for model incinerator	98
Cadmium	7440439	4953	Sewage sludge incineration	Fluidized-bed furnace	50100506	0.74 mg/kg dry sludge	Average of three tests, scrubber	101
Cadmium	7440439	4953	Sewage sludge incineration	Multiple hearth furnace	50100506	9.9 mg/kg dry sludge	Average of 13 tests, scrubber, range 0.26-63	101
Cadmium	7440439	806	Hospital waste incineration	Incinerator	315020	35.2 x 10-4 lb/ton feed	Uncontrolled, test data	9
Caprolactam	105602	2869	Ammonium sulfate production - caprolactam by-product	Rotary dryer	30121009	1.1 kg/hr	Based on test data	129
Carbon disulfide	75150	2824	Synthetic fibers - viscose rayon	General emissions	30102501	55 lb/ton fibers	Uncontrolled, low quality factor	97

A.3 USE OF SPECIES FACTORS

Another technique that may be used to estimate emission of air toxics is to apply species factors to existing estimates of particulate matter (PM) or volatile organic compound (VOC).

Two major speciation manuals are currently available as pointed out in Chapter 3, one for volatile organic compounds and one for particulate matter. The VOC species manual shows percent by weight of specific chemicals in emissions from specific processes. The sources covered in this manual include point and area sources. SCC's are presented where applicable. The manual for particulate matter was designed to provide particle composition data that are useful not only for air toxics emission inventory, but for receptor modeling applications work as well. The manual lists composition data as percent by weight for four particle size ranges, for specific metals, organic carbon and elemental carbon, and for particulate emissions from point and area sources. SCC's provided when applicable. Example of how these tables amy be used in air toxics emission inventory are described below.

Example: Quantifying Species in Particulate Matter Emissions

> Suppose that an agency wished to identify particulate elements that comprise the particulate matter emissions from a primary copper roaster. The PM speciation manual lists species present, or weight percent basis for four particle size ranges from a primary copper roaster as shown in profile 29209 (see Table 6 in Chapter 3 for profile).
>
> If the total PM emissions of the subject plant were 150 tons of particulate per year and the agency is only interest in the fine fraction (i.e., <2.5 μm) for arsenic, then from the profile 29209, arsenic is shown to be 4.2 percent by weight. The estimated arsenic emissions would be 150 ton/year x 4.2 percent or 6.3 tons per year. Similarly, the profile (profile 29209) shows that in the 0-10 μm range, chromium is .042 percent by weight. Then if total PM emissions of sources is 150 ton/year, then the estimated chromium emissions would be 150 ton/year x .042 percent or .063 tons per year.

Before applying the species profile data, the agency should verify that the source is similar to the typical source in that category. Such information and data may be obtained from permit applications, inspection reports, or registration files.

Example: Quantifying Species of Volatile Organic Compounds

> An agency could estimate species emissions from crude oil production - well heads by using the VOC Species Manual. From the VOC manual (profile number 1212, Table 5 in Chapter 3) you may locate a list of

30 compound emitted from this source category. If the agency wants only benzene and toluene, the profile list these compound as .05 and .09 percent by weight, respectively. Based on the total VOC emission from the criteria pollutant inventory, estimates of the two species can be made. Assume the source emitted 100 ton/year total VOC then benzene and toluene can be estimated by multiplying 100 tons/year VOC by the respective percent weight, yielding .05 tons/year for benzene and .09 tons per/year for toluene.

The primary limitations when using species factors are that (1) materials used at each facility will vary, and (2) speciation data are not available for all source categories. For example, a surface coating operation may be known to use varnish and lacquer, but the specific type and its composition are not know. The speciation factors can be successfully used to get a rough emissions estimate of specific pollutants. That level of accuracy may be all that is needed for screening purposes. If a more detailed analysis is needed, the source could be contacted to obtain national safety data sheets for specific materials used. The same calculation methods presented here could then be made using the site-specific species data.

A.4 USE OF MATERIAL SAFETY DATA SHEETS

Suppose an agency needs to speciate VOC emissions from a furniture manufacturing plant. When reviewing permit application files for the source, the agency found information indicating that Supplier X's Enamel 209 and Primer 387 were the raw materials used at the plant and also found that Material Safety Data Sheets for these two products were included in the files. Material safety data sheets generally list the composition of the material by percent weight (Figure A-2).

By obtaining total VOC emissions for the plant from the criteria pollutant inventory and/or permit applications, the emissions of specific toxic pollutants can be estimated using the information on the material safety data sheet. If the data in Figure A-2 represent the enamel and primers used at the plant, and assuming that the plants total VOC emissions were 50 tons per year, then 7.3 tons per year toluene and 1.9 tons per year of xylene would be an estimate of the air toxics emitted.

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	HAZARD DATA
Toluene	14.5 (w)	
Xylene	3.8 (w)	
Ethyl Acetate	5.9 (w)	

Figure A-2. Sample Material Safety Data Sheet: Hazardous Ingredient Section.

A.5 USE OF MATERIAL BALANCES

A material balance can be used to estimate emissions from processes where emission factors, speciation data, or source assessment data are not available. Even where these other tools can be used, the material balance may be the best approach in some situations. The simplest material balances (most conservative) are those that assume most or all of a material used or fed into a process is emitted to the atmosphere. In many cases, this assumption will overestimate emissions; however, for screening purposes, such as assumption may be reasonable. Examples of how a material balance may be used to estimate emissions are provided in this section.

Example: Estimating Emissions of VOC from Air Stripping of Contaminated Groundwater

Suppose that an agency needs to estimate emissions of two solvents (1,1,1-trichloroethane and carbon tetrachloride) from an air stripper used to decontaminate groundwater. Using simple material balances based on concentrations of the solvents in the groundwater and the operating parameters of the air stripper, emissions (lb/hr) of the two solvents can be estimated.

Assume that the groundwater concentrations of the two solvents were:

1,1,1-Trichloroethane	38 mg/l
Carbon Tetrachloride	12.6 mg/l

Then assume that all of the solvent contained in the groundwater is emitted to the atmosphere and that the stripper cleaned 50,000 l of water per hour. Then emissions could be estimated for 1,1,1-trichloroethane as follows:

50,000 l water/hr x 38 mg solvent/l x 1 lb/454 g x 1 g/100 mg = 42. lb solvent emitter/hr

Similarly, the estimated emissions of carbon tetrachloride would be 1.4 lb emitted/hr.

Example: Estimating Emissions of Metals and Organics from Waste Oil Combustion

Suppose that an agency needed to estimate the areawide emissions of cadmium, chromium, and perchloroethylene from waste oil combustion. Using simple material balances based on the concentrations of metals and organics in the waste oil and the amount of waste oil burned annually, and by estimating the amount of metals and organics contained in the fly ash, emissions (tons/year) can be estimated.

Assuming that about 75 percent of the metals in waste oil are emitted (conservative estimate from the general literature), 739,000 gallons of waste oil are burned per year and the oil contains 2.7 mg/l cadmium, the emissions could be estimated as follows for cadmium:

739,000 gal waste oil burned/yr x 2.7 mg Cd/l waste oil x 75% metal emitted x 2.785 l waste oil/galloon waste oil x 1 g/1000 mg x lb/454 g x 1 ton/2000 lb = 0.006 ton/year Cd.

For chromium, the emissions would be 0.085 tons/year, based on 37 mg Cr/l in waste oil.

For perchloroethylene, assume that 1 percent of the organics in waste oil are emitted (99 percent destruction), then:

739,000 gal waste oil burned/year x 448 mg perc/l waste oil x 1% organic emitted x 3.785 l waste oil/gal waste oil x 1 g/1000 mg x 1 lb/454 g x 1 ton/2000 lb = 0.014 ton/year.

For the processes where reasonable assumptions can be made about the fate of a pollutant during the process, the conservative material balance provides a reasonable first estimate of emissions for screening. For processes where a material is reacted to form a product or otherwise significantly chemically changed, the conservative material balance technique is not appropriate. Consulting the literature for more detailed data about the process may provide enough information to allow assumptions to be made about the emission of a specific pollutant.

APPENDIX B

EXAMPLE AIR TOXICS PRODUCTION AND USE QUESTIONNAIRE

APPENDIX B

This appendix is an example of a general production and use survey form designed to acquire information on chemical production, storage, and use at facilities. This type of form may be used as a screening survey to determine who should receive more detailed followup questionnaires. Or, it may also be utilized to gather emergency preparedness data.

To the President or Chief Environmental Officer:

As part of our continuing efforts to improve air quality in _____ the Bureau of Air Pollution Control (Bureau) is now engaged in evaluating the effect of potentially toxic chemical pollutants. The enclosed Chemical Substance Survey is a vital part of that evaluation. We request your full cooperation in this effort.

Your are requested to report materials which are stored or produced on site in sufficient quantities that could potentially pose an immediate or chronic threat to off-site life and health, including emissions from accidental releases. In reporting this chemical substance data, do not report chemicals such as those used in laboratory work, or for weed and pest control, or virgin fuels such as coal or oil.

The questionnaire was designed for a wide variety of operations. Accordingly, some sections may not apply to your facility; simply mark those "not applicable." Remember, it is just as important for this inventory to alleviate concerns about the unknowns by documenting that potentially serious hazardous air emissions are <u>not</u> taking place.

If there is insufficient room on Form 2 to record all of the chemical substances to be reported, please make sufficient additional copies of Form 2 before filling it out.

The Bureau further requests that these forms be filled out separately for each plant or facility operated by the company. Please return the completed forms to the Bureau, at the above address, as soon as possible, but no later than _____.

Questions should be referred to:

Your cooperation in filling out the questionnaire is greatly appreciated.

Sincerely,

COUNTY HEALTH DEPARTMENT

BUREAU OF AIR POLLUTION CONTROL

Chemical Substance Survey

Attached are two survey forms. These forms request two kinds of data:

1. General information such as company name and address, plant Standard Industrial Classification (SIC) code, name of the person filling out the form, and general plant description. These data are requested on Form 1. Use one set of forms for each plant. Please fill out and return Form 1 even if you have nothing to report on Form 2.

2. Chemical substance information: We are interested in determining what chemicals or substances are used, made or stored at this site.

   For the purposes of this study, the scope of the survey is being defined as pertaining to chemical substances which have been found to pose a threat to life and health. The enclosed list of chemical substances are of concern to the Health Department. Use Form 2 to report any of these chemicals which are stored or produced on site in sufficient quantities that could potentially pose an immediate or chronic threat to off-site life or health. The chemicals have been grouped into categories, similar to the ones below to assist you in locating the chemicals that you use:

Acids	Metals and Compounds
Catalysts and Reagents	Monomers or used for Organic Synthesis
Chemical Intermediates	Pesticide Compounds
Chemical Warfare Agents	Plasticizing Compounds
Cyanides	Pharmaceuticals
Flavors and Fragrances	Refrigerants
Fumigants	Solvents
General Use Chemicals	Miscellaneous Chemicals
Industrial Gases	

The basic chemical data are to be recorded on Form 2.

Please fill in all data to the maximum extend possible. We will be glad to answer any questions about this form or the information we are requesting. Just call ( ) _____ - _____. Return completed forms to:

COUNTY HEALTH DEPARTMENT

BUREAU OF AIR POLLUTION CONTROL

CHEMICAL SUBSTANCE SURVEY

FORM 1 - COMPANY INFORMATION

Plant/Facility Location

1. Company Name: _____

2. Company Address: _____

_____

3. City/Zip Code: _____

4. Municipality (or Township): _____

5. Telephone Number: _____

6. Contact Person (Name/Title): _____

Mailing Information, if Different from Above:

7. Company Name: _____

8. Company Address: _____

_____

9. City/Zip Code: _____

10. Plant SIC Code: _____

11. Please give a brief, general description of operations at this plant.

_____

_____

_____

_____

12. Is there an emergency response program to deal with releases of chemical substance in use or storage on your premises? _____

13. If the answer to No. 12 is yes, is the program coordinated with local emergency management agencies (fire and police departments, or other) and if so, which ones? _____

_____

_____

_____

14. Give the plant UTM coordinates, if available: _____

_____

_____

15. Federal Employer I.D. Number for plant/facility name in Item 1.

_____

_____

I certify that to the best of my knowledge, the above information is correct.

_____
Signature (or person filling out these forms)

_____
Name (type or print)

_____
Title

_____
Telephone Number where above person can be reached.

COUNTY HEALTH DEPARTMENT

BUREAU OF AIR POLLUTION CONTROL

CHEMICAL SUBSTANCE SURVEY

FORM 2 - INSTRUCTIONS

Chemicals/Substances In Use.

If there is insufficient room on Form 2 to record all of the chemical substances to be reported, please make sufficient additional copies of Form 2 before filling it out. Use this form to report any chemical substances from the enclosed list, that are stored or produced on-site in sufficient quantities that could pose an immediate or chronic threat to off-site life or health, including emissions from accidental releases.

Item 20 - Commercial Name, Common Name, or CAS Name

Chemical substances should be listed by their most commonly used name. For instance, methyl ethyl ketone (common name) may be referred to as MEK (another common name), 2-Butanone (CAS name) or some commercial name (for example, Jones super solvent). For substances consisting of two or more chemicals, list all know ingredients separately unless there is no information available on the individual ingredients. The CAS name is that name derived from the nomenclature used by the American Chemical Society's Chemical Abstract Service in the 8th Collection Index of Chemical Abstracts.

Item 21 - CAS Number

The Chemical Abstract Service (CAS) Registry Number is a numeric designation assigned by the American Chemical Society's Chemical Abstracts Service and uniquely identifies a specific chemical compound. This entry allows one to conclusively identify a substance regardless of the name or naming system used. CAS numbers for most of the substances of interest here are on the attached list.

Item 22 - Quantity Purchased by the Facility Annually in Pounds

Give the quantity annually purchased by the facility in pounds. If the chemical substance listed in Item 20 is part of a mixture of other chemicals (such as a solution, suspension, emulsion, etc.), list information only for the designated chemical substance in Columns 21 through 26. In Column 20, along with the chemical substance name, give pertinent information on the mixture (such as: "stored as a 1/2% solution in mineral oil", or "chemical is 1000 ppm in an inert compressed gas product"). For this Item, and for Item 23, the amount reported should be the higher of the following two figures:

1. Average of last three (3) years
2. Amount used in 1984.

Item 23 - **Quantity Produced or Manufactured Annual, in Pounds**

Give the quantity produced or manufactured by the facility annually, in pounds.

Item 24 - **Maximum Quantity Stored in the Plant at any one time, in Pounds**

Item 25 - Indicate by using one or more of the following codes the type of airborne emissions of this substance during the last three (3) years.

A - Accidental (only)
B - During Breakdown
C - Continuous During Operations
I - Intermittent
S - During Start-up/Shutdown only
N - There were no air/ emissions

Item 26 - Indicate with "Yes" if there is air pollution control equipment on the source of emissions and with "No" if there is no air pollution control equipment on the source of emissions. (Note: Emissions control for the substance in question.)

If it is more convenient to report your data in units other than pounds, you may do so. However, we request that you also provide adequate information to convert those units to pounds.

COUNTY HEALTH DEPARTMENT
BUREAU OF AIR POLLUTION CONTROL

Chemical Substance Survey - Form 2
Chemical Substances in Use

Commercial Name, Common Name or CAS Name 20	CAS Number 21	Quantity Purchased Annually (Pounds) 22	Quantity Produced or Manufactured Annually (Pounds) 23	Maximum Quantity Stored in Plant at any one Time (lbs.) 24	Chemical Substance Emissions		
					Type of Emissions Code 25	Air Pollution Control Equip. Yes	No 26

I certify that, to the best of my knowledge, the above information is correct.

Date _____ Signature _____ Title _____

APPENDIX C

GLOSSARY OF CHEMICAL NAME SYNONYMS

APPENDIX C

GLOSSARY OF CHEMICAL NAME SYNONYMS

A brief glossary of common synonyms for the substances addressed in this report is listed in Appendix C. The more frequently used names are listed in the left hand column and synonyms in the right hand column. Other synonyms may exist, but more common ones are listed here. Additional synonyms can be found in the EPA CASR or Chemical Activities Status Report (EPA-560/130-80-040a).

GLOSSARY OF CHEMICAL NAMES SYNONYMS*

Substance	Synonym
Acetaldehyde	Ethanal
Acrolein	Acrylic Aldehyde
Acrylonitrile	Propenenitrile
Allyl Chloride	3-Chloropropene
Ammonia	Anhydrous Ammonia
Benzene	Benzol, Phenyl Hydride
Benzo(a)pyrene	3,4-Benzpyrine
Benzyl Chloride	Alpha-Chlorotoluene
1,3-Butadiene	Divinyl, Biethylene
Carbon Tetrachloride	Tetrachloromethane
Chloroethane	Ethyl Chloride, Hydrochloric Ether
Chloroform	Trichloromethane
Chloroprene	2-Chloro-1,3-Butadiene
Cresol	Cresylic Acid
p-Dichlorobenzene	1,4-Dichlorobenzene
Dioxane	Diethylene Dioxide, Dioxan, 1,4-Dioxane
Epichlorohydrin	Chloropropylene Oxide
Ethylene Dibromide	1,2-Dibromoethane
Ethylene Dichloride	1,2-Dichloroethane
Ethylene Oxide	1,2-Epoxyethane
Formaldehyde	Methylene Oxide, Formalin
Hexachlorobenzene	Perchlorobenzene
Maleic Anhydride	2,5-Furanedione
Methyl Bromide	Bromomethane
Methyl Chloride	Chloromethane
Methyl Chloroform	1,1,1-Trichloroethane
Methyl Methacrylate	Methyl Ester, Pegalan
Methylene Chloride	Dichloromethane
Naphthalene	Naphthalin
Nitrobenzene	Nitrobenzol
Perchloroethylene	Tetrachloroethylene
Phenol	Carbolic Acid
Phosgene	Carbonyl Chloride, Carbon Oxychloride
Phthalic Anhydride	PAN
Propylene Oxide	1,2-Epoxy Propane, Propene Oxide
Styrene	Vinyl Benzene, Phenyl Ethylene
Tetrahydrofuran	Diethylene Oxide
Toluene	Toluol, Methyl Benzene
Toluene Diisocyanate	TDI, 2,4-Tolylene Diisocyanate
Freon 113	1,1,2-Trichloro-1,2,2-Trifluoroethane
Trichloroethylene	Ethylene Trichloride
Xylene	Dimethyl Benzene
Vinylidene Chloride	1,1-Dichloroethylene
Vinyl Chloride	Chloroethylene, Vinyl C. Monomer

*Based on NIOSH/OSHA Pocket Guide to Chemical Hazards, 1978, DHEW (NIOSH) No. 78-210 and EPA Chemical Activities Status Report, 1980 EPA-560/130-80-040(a).

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-450/4-86-010		

4. TITLE AND SUBTITLE	5. REPORT DATE
Compiling Air Toxics Emission Inventories	February 1990 (Revised)
	6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Dallas W. Safriet U.S. Environmental Protection Agency	

9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
Pollutant Characterization Section (MD-15) Noncriteria Pollutant Programs Branch Air Quality Management Division Research Triangle Park, NC 27711	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report contains technical materials that will assist state and local control agencies in compiling air toxics emission inventories. It contains a discussion of (1) various considerations that should be made in planning and beginning an inventory and (2) various tools an agency can use to locate potential sources and to estimate emissions therefrom. The appendices contain the data needed to use these inventory tools and some example applications of them.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Toxics Emission Inventories Toxic Emissions Screening Inventory Inventory Procedures Hazardous Air Pollutants		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
		78
	20. SECURITY CLASS (This page)	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE